REPORTS

TO THE

ST. LOUIS MEDICAL SOCIETY

ON

YELLOW FEVER;

CONSISTING OF

THE REPORT OF THE COMMITTEE APPOINTED TO INQUIRE INTO THE RELATIONS OF THE EPIDEMIC OF 1878 TO THE CITY OF ST. LOUIS,

AND

A REPORT ON THE METEOROLOGICAL CONDITIONS AND ETIOLOGY OF YELLOW FEVER, AND OF CERTAIN OTHER DISEASES ASSOCIATED WITH A HIGH TEMPERATURE, AND ON THE TREATMENT OF YELLOW FEVER,

BY

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Although the nature of this production does not allow of a dedication, I may at least be permitted to take advantage of the present opportunity to express my indebtedness to

DR. WM. T. WRAGG,

OF CHARLESTON, SOUTH CAROLINA,

for all my earlier acquaintance with yellow fever at the bedside and for many evidences of generous kindness.

W. HUTSON FORD.

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PREFACE.

At a regular meeting of the St. Louis Medical Society of Missouri, held at the hall of the Polytechnic Building on the 2d of November, 1878, Dr. W. M. McPheeters offered the following preamble and resolutions:

"In order to contribute our part to the important work of securing a full and complete history of the epidemic of yellow fever, which, fortunately, is now rapidly passing into history, be it resolved:

1st. That a committee of three be appointed by this Society, whose duty it shall be to inquire into and report upon all the facts connected with the importation and spread of yellow fever in this city and at the quarantine station during the past summer, and as far as possible, to trace the history of every case known to have been brought to the city, with especial reference to the effects produced on persons brought into immediate contact with every such case.

2d. That the committee be authorized to draw on the Treasurer of this society for such necessary expenses as may be incurred by them in the prosecution of their work; the amount so drawn having first been submitted to the Society for its approval.

3d. That all physicians in possession of facts bearing on this subject, are hereby requested to furnish the same to this committee when appointed."

The resolutions having been adopted at the regular meeting on the 9th of November, the President, Dr. L. Chas. Boislinière, appointed Dr. W. Hutson Ford, Dr. Walter Wyman and Dr. F. J. Lutz, members of said committee, to prepare a report on the

recent epidemic of yellow fever, so far as it relates to the City of St. Louis" (Extracts from the Minutes.).

The undersigned, members of the committee so appointed, having duly considered the most practicable plans for obtaining the desired information, finally determined to issue a circular letter to every practicing physician in this city, with the request that he should notify them by a return card, if any facts were in his possession deemed of value with regard to the object of their inquiry, upon receipt of which, the members of the committee might by a personal interview obtain the data and information concerned. This was accordingly done, five hundred circulars with a return postal card enclosed in each, being sent out as soon as they could be prepared. Some fifty or sixty answers to these circulars were received, and the members of the committee proceeded at once to call upon those who had so responded in the affirmative. In this laborious work they have been sedulously engaged, and the material collected must be regarded as an index of unremitting labor, very greatly in excess of what might be imagined. Often to determine a date, or make investigations with regard to contradictory statements, much time and trouble have been expended. The committee is quite confident, however, that they have very nearly reached the object proposed, and have collected succinct but reliable histories of nearly all the cases of yellow fever which occurred in St. Louis in 1878, and they are at least confident, that they have not failed to follow up the history of any case whatsoever, which has come to their knowledge, either by the system of circular responses, or by direct personal information. In their queries addressed to physicians, it has been the endeavor of the committee to carry out the intent of the resolutions, and all points bearing upon the contagiousness of yellow fever, as observed in the progress of cases developed in St. Louis and its vicinity, and their influence upon nurses and attendants, have been made the subject of careful inquiry.

The committee beg leave to testify to the interest evinced by the profession generally in the subject under investigation, and to the desire shown by all to contribute facts, information and details of cases. Without this most satisfactory concurrence, the objects aimed at could not have been attained.

We also beg leave to acknowledge many favors received from the Health Commissioner, Mr. C. W. Francis, who promptly informed us at the inception of our inquiry, that the records of the Health Office were at our disposal, and who has contributed a general detail of the operations of the Health Department, during the prevalence of the epidemic in the South last season. To the Clerk of the Health Commissioner, Dr. E. W. Jameson, and the Dispensary physicians, and also to the physicians who acted under the Health Department as Inspectors last summer, we are greatly indebted for many hints and clues to cases, as well as personal contributions.

We must also take occasion to express our obligations to Gen. Albert J. Meyer, Chief Signal Officer of the United States, at Washington, D. C., for very valuable meteorological data transcribed from the records, and forwarded at our request, for the use of the committee. These records embrace the meteorology of eleven cities, for all the years recorded under the signal service system in each of them, and in connection with the necrological data for the same period of time, furnish the material for a study, not only of the relation of the epidemic to the City of St. Louis, but also of the meteorological conditions of yellow fever in general.

Other meteorological data, by permission from Washington, have been directly compiled by the committee from the records of the Signal Office in this city, and we beg leave to return our thanks to Sergt. J. H. Weber, in charge of this station, for his politeness in affording us unusual facilities, and in preparing at considerable trouble to himself and the attachés of the office, charts of the relation of sunstroke to the meteorological conditions of the years 1874 and 1878, in this city.

The subject matter of this report has been considered under the following captions:

I. Cases of yellow fever developed in St. Louis in persons coming to this city from Southern cities, where the disease was prevailing.

II. Cases of yellow fever treated at the Quarantine Hospital.

III. Cases of yellow fever arising in St. Louis, its suburbs, at Quarantine, and on board the Quarantine transport steamer, Edwardsville, by contagion from cases developed in persons from points at the South, where yellow fever was epidemic.

IV. Cases either of yellow fever, or closely simulating that disease, arising in St. Louis and its suburbs without known contact with other cases, or where no such contact existed.

V. Classification and summary of all cases of yellow fever occurring in St. Louis and its vicinity in 1878.

REPORT OF THE COMMITTEE

OF THE

SAINT LOUIS MEDICAL SOCIETY

ON THE

RELATIONS

OF THE

YELLOW FEVER EPIDEMIC OF 1878 TO SAINT LOUIS.

SECTION I.

A DETAIL OF CASES DEVELOPED IN ST. LOUIS, IN PERSONS COMING TO THIS CITY FROM SOUTHERN CITIES WHERE YELLOW FEVER WAS PREVAILING.

The committee has spared no labor to obtain a history of every case of this kind, and they believe that they have been successful, in this respect, to a very considerable extent. It is not, however, claimed that every case falling under the category has been investigated, as, no doubt, in some instances, especially where the patient recovered, the attendant physicians did not see fit to report. Moreover, when the committee's card has remained unanswered, under such circumstances, and no information relating to the case has been voluntarily proffered, there has been obviously no way of reaching the case. We believe, nevertheless, that the number of such omitted cases is very small, as the measures taken by the Health Commissioner, early in the season, for obtaining information with regard to the existence of suspicious cases of fever, were so systematic that it was hardly possible that a case should exist without the knowl-

edge of the Health Department. The citizens also watched unusual cases of fever with much suspicion, and did not fail to communicate their apprehensions when cases occurred in their neighborhood. As we have pursued all the clues obtained, we think our investigation has been tolerably close, and beg leave to say once more that every case which has in any way come to our knowledge has been sought out, and the attendant physician personally interrogated with regard to it.

DR. J. M. CLOPTON, 804 Morgan street, was one of the inspecting physicians appointed by the Health Commissioner, Mr. C. W. Francis, to examine into the nature of suspicious cases reported by the police, during the summer of 1878. Dr. C. gives the details of the following cases:

CASE I.—Wm. Johnson, mulatto, æt. 28, unmarried, a steamboatman living in St. Louis, at 1023 Morgan street, but running on lower river within a week of being taken sick. His last trip, however, was up to St. Paul. Johnson had not suffered from malarial fever, to the Doctor's knowledge.

Aug. 9th—Was taken sick this evening with a chill, which was not very severe; an intense fever ensued, with dry skin; pains in the back and head; great disturbance of the stomach; constant nausea, and frequent vomiting of yellow bile; constipation; urine was scanty.

The patient continued in this condition during the next three days, the fever being continuous. He died on the 12th of August, at his home, in extreme prostration. He never vomited black vomit, and the bowels remained constipated until the last. There was yellowness of the conjunctiva, but general icterus could not be determined on account of his natural color.

CASE II.—Madison Castleman, a large, fat mulatto man, æt. about 34, a cook on the river, residing at 1104 North Tenth street, was taken sick, on July 6th, with vomiting and fever. He had no initial chill. The fever did not remit, nor did he have any intercurrent chill or rigor.

July 8th, A. M.—Had been already sick one or two days when seen by Dr. C.; there was nausea and occasional vomiting; the

tongue was covered with a whitish fur; the bowels were constipated, the eyes very yellow; he was vomiting frequently, dark bilious matter; the fever was running very high, and prostration extreme; urine very scanty and deeply colored; the skin was exceedingly yellow. In the progress of the case the vomiting became more frequent, with constant hiccough, great tenderness and excruciating pains in the epigastric and right hypochondriac regions; bled from the nose several times; the tongue, lips and teeth became incrusted with black sordes; intelligence blunted, his condition being one of lethargic and drowsy indifference, not amounting to coma, until some hours before death; he died comatose on the twelfth day, July 18th.

No post mortem was made. The cause of death assigned was "icterus calculosus," but the Doctor affirms that there was no previous history of gall-stones, and strongly inclines to the opinion that the case was one of yellow fever.

Case III.—Edward Coles, white, æt. 32; residence on the corner of Seventh and Morgan streets; a river hand; had been running on the lower Mississippi; the case began with a chill, followed by a fever which was of a continuous type, accompanied by vomiting and pains in the head, back and limbs.

When first seen by Dr. C., on August 27th, in the afternoon, the patient had already been sick a couple of days. He had high fever. There was nausea, with occasional vomiting. The skin was distinctly jaundiced, and the conjunctivæ likewise, and these were moreover injected. The bowels had been costive. He had taken some doses of a febrifuge preparation. These symptoms persisted during several days, the prostration becoming more marked as the disease wore on, and the irritability of the stomach continuing unabated. On the fifth day the fever subsided, leaving him very weak. He never vomited black vomit, or had any hemorrhages. His urine was very scanty. He finally got well.

Case IV.—A mulatto man, from Mississippi, who had come up on a steamer, and was residing at 810 Christy avenue, had an attack very much like that of the others. He arrived in St. Louis, about September 1st, with some cattle, and was taken with a chill, followed by fever lasting three days, when he began to convalesce, and returned to the South. In his function of

inspecting officer, Dr. C. saw several cases of yellow fever which were reported to the Health Office, and sent to Quarantine.

Dr. A. P. Lankford gives the following information with regard to the case of W. P. O'Bannon, very probably one of the first in the United States, and the first or second in St. Louis. Young O'Bannon, who was born in Missouri and reared in St. Louis, left this city in the steamer Commonwealth, for New Orleans, Capt. Shields, his uncle, in command, late in June, 1878, holding the position of Assistant Second Clerk. O'Bannon lived on board the Commonwealth, and while at New Orleans, about the 3d or 4th of July, went on board the Emily B. Souder, then lying at the levee, notwithstanding the prohibition of his uncle against his going on board any such vessel. The Souder had lately arrived from the West Indies, with a cargo of sugar, and at the time of O'Bannon's visit had two cases of yellow fever on board, which had apparently escaped the vigilance of the authorities. It is not probable, however, that O'Bannon came into direct contact with these cases. The Commonwealth lay close to the Souder at the time, and transferred to her deck from the brig five hundred hogsheads of sugar, for the Belcher Refining Company in St. Louis. It is not known that O'Bannon went into the hold of the Souder during the process of transfer, nor is it probable that he did so, as his duty as clerk required his presence on the deck of the Commonwealth. From the time of the transfer until the 12th of July, involving the entire period of the return trip of the Commonwealth to St. Louis, young O'Bannon, who was only 16 years of age, was romping and playing among the hogsheads of sugar, which were on the main deck of the Commwealth, with his sister and cousin, neither of whom were subsequently affected. He arrived in St. Louis on the night of Thursday, July 11, 1878, and seemed perfectly well on the Sunday following, being seen that day by Dr. Lankford, on a visit to the family. The next day (Monday) he complained of inappetence, and of slight chilly sensations. About 5 p. m. he was found by his mother, after a somewhat prolonged search, under the piano in the parlor, in high fever and a profound sleep, from which it was very difficult to arouse him.

Dr. Lankford being called, saw him at 1 p. m., on July 16th. The stupor continued, and the fever did not abate; the tongue was inclined to be dry, and the skin devoid of moisture. The

bowels had been constipated, urine scanty and high colored. There was, as yet, no nervous irritability of the stomach, but much thirst. These symptoms increased in intensity; the patient became delirious during the night, and the fever was observed to be of a continuous character. Some irritability of the stomach had now appeared. At a consultation with Dr. J. K. Bauduy next day, (Thursday) the fever was noted as still continuous; there was frequent vomiting, and about 8 P. M., ejection of unmistakable black vomit, which had begun some four hours previously; the dejections were also very dark. There was no very marked icterus until the morning after this, when suppression of urine was also determined. The patient died on Friday, the 19th of July, 1878, at about 1 P. M., the fifth day of his disease.

At this date, there was no *declared* yellow fever in the United States, except the cases on board the Emily B. Souder; none as yet reported in New Orleans or elsewhere. At the consultation on the 18th of July, the case was declared to be one of yellow fever, and the diagnosis was thoroughly verified at the autopsy, Drs. Lankford, Bauduy and P. G. Robinson being present. (See statements of Drs. Bauduy and Robinson).

Dr. Lankford has seen many cases of intermittent fever this past year. He regards these fevers as having been exceedingly obstinate, requiring the persistent administration of large and frequent doses of quinine and arsenic to overcome them and prevent recurrence. An unusually high temperature, and a disposition to assume a remittent character was common.

DR. J. K. BAUDUY saw young O'Bannon in consultation with Dr. A. P. Lankford, on the third day of the disease, (17th of July). The characteristic symptoms were stupor, almost simulating coma; there were no convulsions until the morning of the day he died; there was much gastric irritability with ejection of glairy matters at first, but the next day, black vomit was thrown up; the icterus was not marked during life, except on the last day. The patient complained of intolerable pain in the head, when the stupor remitted occasionally. Towards the end, the vomiting was very profuse; there was great jactitation and subsultus, and some convulsions. A blister which had been applied

to the nape of the neck became gangrenous even after a few hours. The case, in Dr. Bauduy's opinion, was indisputably one of typical yellow fever.

Dr. Bauduy saw many cases of malarial fever this past year, and regards them as having been very unusually severe, difficult to manage, and strongly disposed toward recurrence.

DR. F. V. L. BROKAW, 201 North Fifteenth street, saw Capt. W. S. Nelson on the 10th of August, 1878. Capt. Nelson was about 60 years of age, a citizen of St. Louis, who was engaged upon the Jetties at the mouth of the Mississippi, having been occupied there from the beginning of the enterprise, and living there. When the yellow fever made its appearance at the Jetties the operatives and conductors of the work became alarmed, and all left the spot who could get away. Capt. Nelson had been more exposed than the rest, and had undergone extraordinary fatigue, having rowed back from New Orleans in a skiff, more than a hundred miles, to the Jetties, almost immediately before he was taken sick. Yellow fever was prevalent in New Orleans at the time, as well as at the Jetties. As soon as Capt. Nelson found that he was sick he started for his home in St. Louis, being on the route nearly or quite three days. He arrived in St. Louis on the morning of August 10th, 1878. He was exceedingly ill, and was taken directly to his house. Dr. Brokaw saw him an hour or two after his arrival. His condition was so grave that he could give no intelligent account of his case. There was great prostration and hebetude, the tongue creamy, and skin already deeply bronzed; he was constantly tossing about, with pains which he said he felt all over him, so great being the jactitation that his relatives could scarcely keep him in bed. He was then occasionally conscious enough to complain of the pain he suffered. There was persistent vomiting of glairy matter, with great tenderness at the epigastrium. There was marked congestion of the vessels of the face and neck. His bowels had been constipated, but on his way up from New Orleans he had taken some compound cathartic pills, which acted. Temperature, 102° or 103°; pulse 100. Dr. Brokaw estimated the case to have been in progress not quite four days, when he first saw him. The urine was scanty, but not suppressed. The vomiting was arrested. On the next day (August 11th) he was apparently better; the pulse

was fair, and the irritability of stomach, the vomiting, pains, and temperature, were somewhat abated. The symptoms continued the same until about 5 P. M. on the 12th, when the pulse became exceedingly slow, the delirium and hebetude more marked, and the breathing hurried. Under stimulants he rallied a little. At this time he was semi-comatose, and the urine was found to be loaded with albumen. He never vomited black vomit, or passed similar matter by stool, and gradually sank, and died about 5 A. M. on the 13th of August. When he arrived his condition was such that he could not be undressed in the upright posture; after he was laid upon the bed his clothes were removed and a bath of tepid water given him. Although his family and servants were in the closest proximity to his person from the first, engaged in nursing him and controlling his movements, nobody in the house or who had been near him was subsequently attacked with fever. The apartments were thoroughly disinfected after his death; his clothing had been disinfected carefully before.

Dr. Brokaw saw another case of yellow fever in a child 7 years of age, Sidney Ellis. He had come from New Orleans with his parents and grandmother, by railroad. The grandmother was stopped, sick with yellow fever, at the Quarantine Station, on August 27th or 28th. About three days after arriving in the city the child was seized with a chill about 5 A. M. Dr. Brokaw saw him about twelve hours after this. At his visit there was high fever, with some delirium; temperature 103°; pulse 120; marked congestion about the face and neck, with capillary sluggishness; much tenderness at the epigastrium, nausea, and occasional vomiting. Dr. Brokaw administered veratrum at once, and kept the pulse at about 80 per minute, cold applications being meanwhile applied to the head. The temperature was thus lowered to about 100°. The case progressed favorably up to the night of September 2d, which was the evening of the third day of the disease. He was then removed by the Health Department to Quarantine, but the treatment was nevertheless continued. The case continued to progress favorably, and recovered.

Dr. Brokaw has seen many cases of malarial fever this past summer. Such cases, in his opinion, have been of more than usual obstinacy and severity, the temperature running very high—as high in several of them, as 105°. The cases were marked by the presence of delirium and severe headache in the younger patients, and in some few adults likewise.

DR. GEO. C. PITZER, 1218 Monroe street, does not think that malarial fevers have been more than usually prevalent last year, or that such affections have been more severe than in preceding seasons. The Doctor had heard of one death by malarial fever.

Dr. Pitzer furnishes the following details with regard to those cases of yellow fever seen and treated by him during the summer of 1878:

Mrs. W. was taken sick on August 11th, the next day after arriving in St. Louis from Port Eads. Dr. Pitzer saw her first on the evening of Monday, the 12th. She was exceedingly restless, complaining greatly of intense headache, and an almost intolerable pain in the back. The face was flushed; the eyes red and watery; the skin hot and dry; tongue but slightly furred; pulse 60 per minute; temperature 103°; great thirst; irritability of stomach, and vomiting of glairy matters mixed with striæ of blood. The bowels were constipated; urine dark colored, but in normal quantity; intellect clear. The next day there was but little change, but towards midnight the headache became intolerable, and the pain in the back was aggravated. Temperature about the same, and the pulse only 60. On the 14th inst the patient was a little more comfortable. The urine was normal in quantity, dark colored, and laden with albumen. She passed a quantity of dark, exceedingly offensive matter, by stool, after a salt-and-water injection. During the night of the 14th the temperature began to decline, and by Friday, the 16th, had fallen to 100°. Twelve hours later there was some stupor, with coolness of the extremities, and a cold perspiration. There was much nausea, with ejection of a few mouthfuls of dark greenish fluid. Black vomit did not, however, make its appearance, and the patient recovered after about two weeks' illness. The treatment was by gelseminum, aconite, bromide of sodium, and strychnia by enema; in the second stage ice and champagne in small amounts were given.

Dr. Pitzer also attended Mrs. W.'s child, about four years of age, taken sick the day after its mother, which recovered after passing through all the stages of yellow fever.

Dr. Pitzer's third patient was Mrs. K., 3413 Market street, who was taken sick on August 22d. She was thus attacked fifteen days after leaving Port Eads. When first seen the temperature was 102°; pulse 110, and rather feeble; tongue slightly furred, with reddened tip and edges; intelligence good; some headache;

slight pain in the back, restlessness, thirst, and gastric irritability. The face was flushed, the eyes injected and watery; frequent epistaxis; constipation; urine scanty and high colored, but not albuminous. On the third day the urine was found heavily laden with albumen. On the fourth day she ejected a quart of black vomit. The pulse was weak, surface cold and clammy; expression extremely anxious; epistaxis; uterine hemorrhage, great thirst, and extreme restlessness. She recovered after about two weeks' illness. The treatment was by gelseminum, aconite and bromide of sodium to control the nervous symptoms. No nourishment was allowed, and perfect quiet enjoined.

DR. J. M. SCOTT attended Mr. E. Nelson, residing on Eleventh street, between Brooklyn and Webster streets. Nelson was a man of about 45 years of age, who had been working at the Jetties, at Port Eads, ever since the beginning of the enterprise. Shortly after the fever broke out at Port Eads he was paid off, and in company with some dozen others left for St. Louis by railroad. Two of this company sickened and died in New Orleans, on the way. Nelson arrived in St. Louis on the morning of the 10th of August. Dr. Scott saw him two days after his arrival. He had a continuous fever, which still ran high, with much thirst and irritability of stomach. The skin and conjunctivæ were already much colored; tenderness at the epigastrium; great anxiety and apprehension; partial suppression of urine. He did not vomit black vomit. Delirium supervened about the fourth day, and he died, comatose, on the fifth.

Dr. Scott has seen about the usual number of malarial cases this season. The intermittents were of unusually rebellious type, prone to take on a remittent character and to recur, requiring large and repeated doses of quinine to arrest them. There was a good deal of delirium, prostration, and congestion in some few of the cases.

DR. A. LULEFF No. 322 Walnut street, states that on August 11th, he was called to see H. Holland, 602 South Second street, a foreman of the works at Port Eads, who arrived from that point the night before, by railroad.

Premonitory symptoms of the disease had been developed before the patient left New Orleans. From ten to twelve days before the doctor called the patient had been drinking whisky incessantly, and had eaten nothing. When first seen the symptoms were those of gastritis. There had been no constipation, and the urine had been normal, at least no statement to the contrary was made. The pulse was below the normal and weak; there was no discoloration of the skin or conjunctivæ. Nothing could be retained by the stomach; the vomited matters were of a dark, green color; no increase of temperature. Dr. Luleff visited the patient twice on Sunday, August 11th; the next day the symptoms were the same with the addition of epigastric tenderness.

On Tuesday the symptoms were the same; up to that day the passages had been regular and of normal appearance. After that the bowels were not again opened. On Tuesday night, upon inquiry, the patient stated that he had not passed urine for two days, he believed.

The next day the symptoms were the same, with the addition of some hebetude, but there was no icterus until about 8 P. M., on Wednesday night and the patient died one hour after midnight. Dr. Frazier, Sr., had been called in consultation. Dr. Luleff saw during the summer and fall a larger percentage of malarial cases than usual.

In the same room with the patient three other men slept, but none of them took the fever.

DR. J. T. PIRTLE, 2602 Chouteau Ave., treated David Matthews, æt. 21, a laborer on the Jetties at the mouth of the Mississippi. Matthews was one of the twelve men who left the Jetties together, during the second week in August, 1878, having been there all the year, arriving here on the 15th of August. He was taken sick two or three days after reaching St. Louis, with a heavy chill, followed by fever, pains in the head, back, etc. The fever was continuous. There was great gastric irritability, with vomiting of bilious matter at first, and eventually of true black vomit. The patient also passed black, tarry, stools. There was no suppression of urine, but great anxiety, restlessness and moaning. He died on the fourth day.

Dr. Pirtle had not seen more cases of malarial fever last season than usual, nor were the attacks, in his experience and judgment, more obstinate or severe than in previous summers. The Doctor states that he had heard of a death by congestive chill in his neighborhood.

Dr. H. H. Mudd, 502 North Fourteenth street, furnishes the following details of three cases of yellow fever:

Case I.—Mary Dorfina, residing at the corner of Tenth and St. Charles streets, æt. 18, white, born in Italy, unmarried. Had come directly from Columbus, Ky., by railroad in company with other refugees from yellow fever. She was much alarmed at what she saw on the cars in the sickness of these refugees. It is very probable that Mary Dorfina was herself a refugee from some point where yellow fever was prevailing, although for reasons easily guessed this was not admitted. She arrived in St. Louis about August 16th or 17th.

August 20th, 9 a. m.—Presented herself at the office with great pain in the head, from which she had been suffering since the night before only. There was no history of a chill, the bowels had been constipated; she was very weak and nervous; she had never had yellow fever, and had been living at the South only for a few years, though her actual point of residence could not be ascertained; temperature 101°; pulse weak; tongue coated, but no nausea; she seemed very anxious and agitated; on the night of the 20th she slept well and seemed better next morning.

August 21st—Less headache than the first day, but irritability of the stomach with occasional vomiting set in, which was relieved for the time by milk and lime water; there was continuous fever, which, however, did not run very high.

August 22d—The headache has increased in severity, and the fever still continues; she is more restless; temperature from 101½° to 102°; the vomiting reappeared and took on the characteristics of unmistakable black vomit. She died at 11 o'clock a. m., August 23d, having become quite yellow. No post mortem could be had, but the general icteroid hue was still more manifest after death.

CASE II.—Nichols, a mulatto man, æt 26, residing at 417 North Eighth street, a steamboatman, having his home in Kentucky. He was a porter of a steamboat which had lately come to St. Louis, which had had some cases of yellow fever on her during the trip.

August 23d—Had not been feeling well for a day or so; is now languid and dull, inclined to stupor; and at times restless, refusing to remain in bed, and expressing fear that he was going to have yellow fever; he did not complain of much pain of any kind; never had had a chill, and had no subsequent one during his illness; there was constant nausea and occasional vomiting; the fever was not very marked and was altogether subacute; no appetite; milk and lime water was given with apparent temporary benefit; the fever, of a low character, continued for several days, the temperature varying from a normal grade to 101°, never being very much exalted; the pulse was but little quickened at first, and after some days declined to forty or fifty; the vomiting meanwhile had taken on the character of black vomit which he ejected from the third to the fifth day of the attack almost without apparent effort. The symptoms at length improved, he seemed decidedly better and had apparently begun to convalesce; his appetite returned, the nausea disappeared and he took some soup from time to time; the fever had left him entirely and he gained in strength, and at length took his meals regularly and with appetite. About the 30th of August, he was suddenly taken with a severe pain in the calf of the right leg, which swelled rapidly; the skin becoming tense, red, and shining; fever set in; warm fomentations were applied and the swelling incised freely; no pus, however, was discharged from the incision; there was only sanious oozing. The next day the skin and deeper tissues of the extremity began to slough; incisions were again made, more freely still; he had become jaundiced a day or so before the appearance of this phlegmonous inflammation, his eyes having become very yellow. He died on the 4th of September. No post mortem.

CASE III.—A traveling salesman from Brownsville, Tenn., æt. about 35, residing at 604 Market street, came directly from Brownsville to this city about the 10th of September, 1878. He had been feeling badly for several days with gastric disturbances, nausea and inappetence. When first seen his pulse was weak, 60;

temperature not above 100°; there was nausea and loss of appetite. He continued in this condition with but little fever, and this of a variable character, for a week or ten days, meanwhile becoming a little jaundiced; the eyes became yellow; the skin was dry and rough; the urine scanty for several days, and at one time showing a trace of albumen; the bowels were relaxed. Dr. Mudd continued to see him during a period of four weeks or more, and he finally made a slow and unsatisfactory recovery.

Dr. Mudd never heard of any extension of the disease from either of these cases to nurses or others who came into contact with them. In his practice the malarial fevers of 1878 were not more frequent nor intense than usual.

DR. W. M. MCPHEETERS, 1000 Olive street, reports the case of Mrs. Nichols, æt 25 or 30, who had been living in Galveston, Tex., but had been on a visit to Vicksburg. She left Vicksburg by rail on August 19th, 1878, and went to Louisville, arriving thence, also by railroad, in St. Louis, on the morning of August 22d. She had a heavy chill on the cars on the night of 21st of August. Dr. McPheeters saw her first at 11 A. M., on the 22d. There were intense pains in the back, head, and limbs; the temperature was at least 104°; she was perspiring profusely; much irritability of the stomach with constant vomiting of every thing swallowed, even water; the vomiting continued through the ensuing night; great restlessness; the fever was continuous.

On the 23d the symptoms were unchanged; there was great alarm, and that night, the irritability of the stomach was even exalted; on the 24th there was some abatement of the symptoms; on examination of the urine it was found free from albumen; there was no suppression at any time; temperature 103 3-5°; pulse 100; perspiration still profuse; pain in the head and back diminished. About the 26th or 27th of August she was decidedly better, and left the city for the South, ultimately recovering. The treatment was mainly expectant, consisting of mild purgation, blue mass and quinine.

Dr. McPheeters also saw Mr. Geyer Small, a young man of twenty, born in St. Louis, and engaged as second clerk on a river steamer plying on the lower Mississippi. On the way up the steamer touched at Natchez, and at intermediate points, where

the yellow fever was prevailing, arriving in this city on the evening of August 30th. Mr. S. passed the night of the 31st on board the steamer, where he had a severe chill, followed by high fever. Dr. McPheeters saw him about 12 M. on that day. There was some distinct remission in the fever, great gastric irritability, and much vomiting. Dr. McPheeters was at first disposed to hope the case might prove one of remittent fever.

On Sept. 2d, the pulse was 80; the tongue coated; much pain in the back and head; urine normal in quantity, but high-colored, and some tinging of the conjunctivæ.

Sept. 3d—The stomach had become more irritable; some somnolence; temp., 103°; pulse, 80; skin dry and harsh. The next day subacute delirium set in, and the somnolence increased. He still passed his urine, which contained much bile, and let fall a copious deposit. The temperature declined to 100 2-5°; pulse, 80; skin still dry. He now retained his medicine, and took some little nourishment.

Sept. 5th—Temp., 101°; pulse, 75; hiccough; delirium; jaundice increased; much congestion of the surface.

On the next day, temp., 99 3-5°; pulse, 80; no albumen in the urine.

Sept. 7th—Still flighty; passes high-colored urine; constipation; pulse, 78; temp., 99 2-5°.

Sept. 8th—Symptoms rather more marked; stupor more decided; partial suppression of urine; semi-conscious.

Sept. 10th—Vomits black vomit, though not copiously.

During the following two days he had several convulsions, with extreme agitation and ataxia. The skin and eyes became very yellow, and he died on the 12th.

Dr. McPheeters has seen a good many cases of malarial fever during the summer of 1878, in St. Louis. He does not think his cases were peculiarly obstinate or severe, although he observed, in some instances, a disposition of the intermittents to become remittent, but not more so than in past years, in his opinion. Dr. McPheeters has seen no instance, in his practice, of a propagation of yellow fever from the sick to attendants or neighboring persons. Careful hygienic precautions were taken in the two cases of fever above reported to prevent subsequent infection. In the second case the bedding was burned.

DR. E. H. GREGORY, 1006 Olive street, states that towards the latter part of August, 1878, he saw a case at the St. Louis Mullanphy Hospital, which he diagnosed as yellow fever at the time. The patient was a man about 30 years of age, a refugee from the South, who had come up the river by steamer to this city. When first seen he had been sick three or four days, and was unable to give any very distinct information about himself.

The prostration was intense; much sighing and moaning; great irritability of stomach, and frequent vomiting of characteristic black vomit. The tongue was coated with a yellowish creamy fur; bowels constipated; partial suppression of urine. There was great congestion of the skin, and suffusion of the eye; the capillary paralysis was well marked. The conjunctivæ were slightly tinged, and there was some general icteroid coloration well marked after death. The patient lived forty-eight hours after entering the hospital.

Dr. Gregory saw another case in consultation with Dr. McPheeters.

Dr. Gregory had seen fewer cases of malarial fever last season than usual. In his visits to the country, the local practitioners have generally informed him that malarial affections have been decidedly less prevalent last year than in past years. The cases of malarial fever seen by Dr. Gregory were not, he says, of especially bad type. No instance of the propagation of yellow fever from a patient to another individual has fallen under Dr. Gregory's observation this past summer.

DR. E. A. DE CAILHOL, 2613 South Seventh street, has had a large experience in yellow fever in the South, especially in New Orleans. He details the following cases occurring here last summer:

Mrs. Fryer, aged 36, a stout and plethoric woman; married; had lived both in Memphis and New Orleans. When the fever broke out, she left for St. Louis, arriving in this city on the 15th of August. She had passed her menstrual period, and thought she might be pregnant, but this could not have been the case, as menstruation came on again after the attack detailed below. Ten days passed after her arrival, and she was taken suddenly sick on the 26th of August. Dr. De Cailhol saw her on that day

at 7 P. M. She had no chill, the disease coming on with fever and pain in the head and back. The tongue was coated, and the gums were covered with a whitish induitus, where they overlapped the teeth; bowels constipated. The conjunctivæ were injected. She was very anxious, sleepless and restless, and very much alarmed, anticipating death by yellow fever. Prostration of the forces was great. Cathartics produced numerous bilious passages, but the fever increased in intensity. She was ordered to take a tisane of cassia fist, lemon, etc., through the day. At 7 P. M.—Temp., 104°; pulse, 106 or 108; face flushed; delirium; fever running very high. Ordered tinct. aconite and tinct. belladonnæ āā gtt. xx in ℥iv of water; tablespoonful every half hour, alternately of each, during the night.

Next morning the fever was not much reduced; tongue still coated; thirst very considerable; still delirious; had passed no urine for twenty-four hours. She was ordered another cathartic dose, and to continue the belladonna and aconite, alternately. By 7 P. M. (Aug. 27), she had had a dozen passages of yellow bile, but had passed no urine; the fever was a little reduced, but not as much as had been hoped for. Gelseminum was now substituted for aconite, and given alternately with the belladonna every half hour or hour, in the same doses.

Aug. 28th, 8 A. M.—Dr. De Cailhol found her very weak; black vomit had appeared; she was constantly nauseated; she threw up black vomit three or four times. Ordered 1-100 of a grain of arsenic every hour, and to continue the aconite and gelseminum, if the symptoms did not become aggravated. 8 P. M.—Her intelligence was better. On being requested to pass her urine, she appeared a little astonished that she had not done so, and succeeded in passing about two ounces of thick and exceedingly offensive urine. The fever had now greatly abated. Pulse, 86 or 90; temp., 101°. The irritability of stomach declined a little. She had not vomited after taking the third pill of arsenic.

Aug. 29th—In better spirits; fever absent; passed her water regularly; bowels continued to act. Great care in diet was observed.

On the 31st of August, she was able to set up, and was pronounced convalescent. There was no extension of the disease from this case.

Dr. De Cailhol saw many more cases of malarial fever during

the summer of 1878 than usual, and the symptoms were, in his opinion, decidedly more marked than in previous seasons. Delirium and congestion of the brain were not unusual, and many of the cases were uncommonly severe.

DR. G. H. CONZELMAN, 1417 Carr street, details the case of Mr. J. Stewart, æt. 50; a refugee from Memphis, residing at 1014 North Sixteenth street. He was a traveling salesman; a man of slender build, and nervo-bilious temperament; born in the State of New York. He had lived in various places, and had been in Memphis only a few years.

He left Memphis on the 22nd of August, 1878, being sick at the time, hardly able to walk, but slowly convalescing after an attack of fever, from whose seqnelæ he continued to suffer long after his arrival here. He stated that he had been taken sick about the 12th of August, with a chill, followed by high, continuous fever, never having any subsequent chill. He had never had yellow fever before. Came up to St. Louis by steamer, and and arrived here on the 26th of August. He was first seen by Dr. Conzelman on the evening of the same day. The tongue was parched; skin shrivelled; circulation feeble, and pulse devoid of elasticity; there was great sensitiveness to pressure in the epigastric, hepatic and splenic regions; he was often nauseated, and vomited glairy matters occasionally; had frequent dark and very offensive evacuations; micturition was difficult, the urine being very highly colored, scanty and albuminous; there was much thirst, and little or no desire for food. He stated that dnring his attack in Memphis he had vomited dark matters, of a *bilious* character, as he thought. There had been no hemorrhages.

Dr. Conzelman saw him six or seven times altogether during the six weeks that he remained in St. Louis. Great care in diet was enforced, and he finally recovered. Dr. Conzelman does not doubt but that this was a case of yellow fever, indeed, one of the first occurring in Memphis.

No extension of this case occurred to any of this man's nurses or attendants in St. Louis, no febrile disease of any kind having been heard of among them.

DR. P. F. WEIGEL, 1103 South Seventh Street, details the following case: Mrs. Freiburg, æt. 50; married; a native of France; resident in St. Louis about the year 1850, after that in Europe, and for several years past in Galveston, Texas. Fearing an outbreak of yellow fever in Galveston, early in August, 1878, with the rest of her family, she left that city for St. Louis, via New Orleans. She remained in New Orleans three or four weeks, where her eldest son, 23 or 24 years of age, contracted yellow fever and died after a few days illness. Immediately after this occurrence she left New Orleans by railroad and arrived in St Louis on the 28th day of August, stopping at the Laclede Hotel. Dr. Weigel was called to see her the night of her arrival. He found her very anxious and excited, and complaining of much pain. She had been liable to bilious disorders for some time, and admitted that she felt unwell in New Orleans before her departure from that city. There was great prostration; pain in the epigastric region and liver; acute headache and pains in the limbs; constant nausea; great thirst; constipation; the conjuntivæ were markedly yellow, and the surface generally distinctly yellowish; urine high colored; marked sluggishness of the capillary circulation everywhere; great restlessness; the tongue coated; pulse, full, 75; temperature high, but not noted. She begged for morphine to allay her pains and distress, but this was not allowed as Dr. Weigel is opposed to the use of opium and its preparations in yellow fever and congestive forms of fever, as well as in cholera. The patient was enveloped in a wet sheet and an emetic of ipecacuanha (grains twenty) and a-half grain of tartar emetic given. This was repeated until copious vomiting was induced and dark matters passed per anum. On the first day the wet sheets were renewed every hour.

August 29th.—She was distinctly better; drank water freely, and took some iced champagne. The wet sheets, were now renewed every four or five hours. No mercurials were given. The pains were most wholly abated, and she had slept well.

The wet sheets were used altogether during forty-eight hours. Dr. Weigel continued to visit the patient for a few days, during which time she steadily improved, being out of danger on the third day after he first saw her. She had been feverish and had suffered from headache ever since leaving New Orleans, and indeed before that, as stated. Her attack lasted about eight or nine days; she had never had yellow fever while a resident in the South.

DR. JOHN T. HODGEN, 502 North Fourteenth street, communicates the following case: "Mr. Vallé Rozier, a native of New Orleans, just from that city, called on me on the 28th of August, 1878. He had no fever but was nervous and restless, evidently much excited; his bowels had been constipated; he had been drinking freely, but had not, it seems, got drunk. He was so nervous that he could not remain quiet.

Aug. 29th—Gave him quin. sulph., (grains twenty) in eight pills; one every two hours. On Sunday, the 2nd of September, I was called to see him at 1210 Washington avenue. He was in a chill at the time of my visit, and later in the evening this was followed by a high fever; he was ordered some sp. æth. nitros. and tinct. gelseminum. On the morning of September 3d, he had no fever; ate a good breakfast; ordered quin., grains four, every two hours in pill; in the afternoon the fever returned; repeated the nitre. and gelseminum. He had little fever during the following night, with shifting pains in the knees, back, legs and head, and was somewhat restless. Continued the quinine.

Sept. 4th, A. M.—Some fever; pulse, 90, soft, of good volume but very compressible; pupils a little large; vessels could be seen on the conjunctivæ, but the eyes were not markedly congested, so little indeed as not to attract attention. Continued the quinine in doses of four grains every four hours in solution. 3 P. M.—Nauseated; has taken no food; temperature, 103½°; pulse, 100, soft, compressible and of good volume; skin moist, but not perspiring freely; urine of sufficient quantity and normal color, of acid reaction, sp. gr. 1016, no albumen. 8 P. M.—Pulse, 80; skin not hot, soft and moist. 9:30 P. M.—Pulse, 76; perspiring quiet; no pains in the limbs; conjunctivæ not congested; urine acid, sp. gr. 1011, devoid of albumen; temperature, 101°; continued the quinine.

Sept. 5th, A. M.—No fever; pulse, 76; temperature, 99°; perspiring; slept well; urine abundant. 3 P. M.—Condition the same. 9:30 P. M.—Pulse, 60, soft and compressible; skin moist and cool; temperature, 99½°.

Sept. 6th—Continued to improve.

Sept. 7th—Dismissed as well."

DR. HEITZIG, 1409 Carr street, details the following case: Mrs. Mary Gardner, of St. Louis, left this city early in 1878 for New

Orleans, with her husband. When the yellow fever broke out there her husband fell sick with it, and she nursed him. After a few days, when he had convalesced up to a certain point, though he afterwards relapsed and died, becoming alarmed for her safety, he insisted upon her leaving the city. She accordingly came to St. Louis by railroad, and soon after her arrival here, viz., on the evening of the 26th of August, she was taken with a chill. On the third day of her illness she began to vomit blood and continued to do so up to the time of her death, which took place on the 2nd of September.

She was first seen by Dr. Heitzig on August 28th. There was great prostration; slightly furred tongue; no diarrhœa, and the conjunctivæ were injected. On the third day the tongue was more furred, and there was partial suppression of the urine during the last two days. Her head was not affected, and intelligence remained perfect until death. She was not sent to Quarantine,—dying in the city. Toward the last the skin became markedly yellow, and the whole surface much congested. There was no extension of her disease to attendants or any one in contact with her.

DR. NEWELL, 2624 St. Louis Avenue, states that he saw a suspicious case of fever, about Sept. 1st, 1878, in a gentleman æt 35, one week from Memphis. The fever was of remittent character but with an unusual amount of tenderness at the epigastrium, and vomiting, with malaise and pain in the back. There were no hemorrhages. The patient recovered under quinine after a couple of weeks. Dr. Newell was at the South during the epidemic of 1878, mostly in New Orleans. He had seen a great deal of yellow fever on the Mexican border in 1872 and 1873, having suffered from the disease himself in 1872. Dr. Newell states, that as far as he could judge, and was informed, no less than 40,000 or 50,000 cases occurred in the city of New Orleans during the late epidemic, of which at least sixteen per cent were fatal. Dr. Newell is strongly inclined to believe in the contagious nature of yellow fever, on the basis of a certain predisposition. He is cognizant of no facts opposed to this view, and thinks that yellow fever must be regarded as a malignant, bilious, or malarial fever, and that it is always based on malarial intoxication.

DR. WALTER COLES, 3007 Olive Street, publishes a case of yellow fever in the *St. Louis Medical and Surgical Journal* for Nov., 1878. The patient, M. C., æt 17, arrived in this city from the South on Sept. 1st, sick with fever, which had ensued after slight chilliness the night before. At his hotel, he lay in a semi-unconscious state for forty-eight hours. Dr. Coles first saw him at 8 A. M., on Sept. 3d. The patient's condition was as follows: Temperature, 107°; drowsy; eyes much suffused; utter indifference to what was going on around him; skin of a dusky reddish hue, some conjunctival tinting, and some yellowness of skin, which became more marked during the two succeeding days. Constipation; urine high colored and scanty; tongue moist, and thickly coated with a yellowish creamy fur. Pulse was at no time over 90, full and very compressible. Patient did not complain, but admitted that he had headache, and pains in the back; threatened suppression. On the morning of the 4th of Sept., temperature, 103°; pulse, 88; had been quite delirious the preceding night, but now passed his water a little more freely, without so much of the vesical tenesmus which troubled him the day before; urine albuminous.

September 5th—Apparently better; temp., 101½°; pulse, 84; sweating; urine still albuminous, but more abundant. At 5:30 P. M., of the same day there was marked amelioration of all symptoms; temperature, 100°; pulse, 80.

September 6th—Temperature and pulse nearly normal; skin still yellow, but moist. The patient recovered, though left very prostrate and anæmic. There was no black vomit, nor even severe vomiting in the case. The treatment was by veratrum viride and jaborandi, given early and continuously up to the fifth day, and then followed by quinine.

DR. WALTER WYMAN, Surgeon of Marine Hospital in St. Louis, reports the following:

United States Marine Hospital, St. Louis.—E. C. Rathburn, white, æt. 42, carpenter of the steamer City of Alton, was admitted to the hospital, September 2d, 1878. The patient had recently returned from New Orleans with the above mentioned boat, and was taken sick the day of arrival. For two or three days, he was treated at his hotel by other physicians, when the case being one of suspected yellow fever, and causing alarm to

the people of the hotel, he was ordered to Quarantine by the Health Officer of the city, but at his own earnest request, was brought to the Marine Hospital instead. He was a man of large frame and powerful build, and would not at first acknowledge that his disease was anything but an attack of bilious colic, to which he was frequently subject. On his arrival, the prominent symptoms were fever, nausea, emesis, epigastric tenderness, cephalalgia; yellowness of conjunctivæ, with marked suffusion; anxiety of mind; constipation; partial suppression of urine, and tongue covered with a creamy fur. From the time of his arrival until his death—a period of thirty-four hours—the patient voided urine but twice. The first time, after leaving his conveyances (quantity unknown), the second time, only a teaspoonful, which on examination, was found to be heavily loaded with albumen. After admission, the symptoms rapidly progressed, and were typical of yellow fever. The congestion of the liver was marked, and the one stool which the patient had was small and clay colored, showing absence of bile. On the 3d, there was an abatement of the fever, and appearance of black vomit. The mind was clear, and remained so until death. On the night of the 3d, icterus became manifest, and on the morning of the 4th (4 o'clock) the patient died. The black vomit was copious, and the skin, especially after death, was of a deep yellow hue in its pendant portions, showing hemorrhagic extravasation.

The patient died in a state of collapse, without coma, convulsions or delirium. The case was entirely typical throughout.

DR. P. G. ROBINSON, 1523 Olive Street, was present at the autopsy of the youth, O'Bannon, early in August. The patient had all the characteristic symptoms of yellow fever, vomiting black vomit, which was found abundantly in the stomach and intestines after death. The skin was intensely yellow. This case occurred a few days after the patient's return from New Orleans, where, as elsewhere detailed, he had gone on board an infected vessel. From the facts observed upon autopsy, Dr. Robinson affirmed positively that the case was one of yellow fever. This occurred early in the season, before there was any report of the prevalence of yellow fever in New Orleans.

Dr. Robinson saw and treated Mr. B. McSorley, steward of the Quarantine Hospital, whose case is described under another caption.

Dr. Robinson treated a man named Nelson, who had arrived on a boat from Vicksburg, although he was himself from Greenville, Miss. The patient was first seen on the 6th of September. He had been taken with a chill and general malaise on the boat. On the first day at 12 P. M., the temperature was 101°. There was at the same time, some slight irritability of the stomach, and tenderness at the epigastrium. A smart dose of calomel procured several bilious stools. The irritability of the stomach, and tenderness at the epigastrium, became more intense during the second and third days, and black vomit set in. The skin assumed the usual icteric hue, but there were no hemorrhages. He died on the evening of the third day.

Dr. H. C. Davis, physician in charge of Quarantine, was attended by Dr. Robinson. His case is elsewhere reported.

Mr. McSorley's daughter, also seen by Dr. Robinson, was sick while he was attending Dr. Davis. Her case is described further on.

Dr. Robinson has seen much malarial fever this year. He thinks there has been more fever of remittent type, (though not of intermittent) in St. Louis the past year, than he ever saw before. In his opinion, the type of malarial fever during the past season has been extraordinarily severe, being marked by great prostration, high temperature, delirium, and inordinate gastric derangement. Unusually large doses of quinine persistently employed, were found necessary in a large number of cases.

Dr. Robinson admits the transmissability of yellow fever after long exposure, from the sick to those about them. He does not think he has any reason to believe that a predisposition towards malarial fever, renders an individual more subject to the disease than others.

DR. B. ROEMER, 1204 Chouteau avenue, states that he was one of the health officers appointed during the yellow fever epidemic to visit and investigate suspicious cases occurring within the Second Police District, embracing the portion of the city between Chouteau avenue and Meramec street, and the river to the western limit. The Doctor treated cases during the epidemic of

1854, in New Orleans, and of 1855, in Norfolk, Va., and is familiar with the disease. The Doctor discovered five or six cases, all of which were sent to Quarantine, but desires to call attention particularly to two.

CASE I.—Mr. W——, a resident of Memphis at the outbreak of the epidemic, left that city, about July 10th, with his family, going to a watering place in Arkansas, thirty miles from Memphis. Remaining there three weeks, as the epidemic did not abate in Memphis, he determined to visit a member of his family in St. Louis, and arrived here on or about the 1st of September. Dr. Roemer was called, in conseqnence of a report by the neighbors to the Police, on the 7th of September, and found the patient to be a boy six years of age. There was nausea, with vomiting of yellow, bilious matters, and yellow discoloration of the eyes and skin. The first symptoms had appeared on September 5th, and the child died on the 8th. The case occurred near the French market. The causa mortis, as given by the attending physician, was diphtheria. On the 10th, two days after the child's death, Dr. R. revisited the premises, and satisfied himself that the child died of yellow fever, having been shown some rags bearing unmistakable traces of black vomit.

DR. R. J. O'REILLY, 602 North Eighteenth street, states that some time in September, 1878, he was called to see an Italian, æt. 40, married, who had been living in Memphis, and had lately come to St. Louis from that city on business. He had been feeling badly in Memphis, and was sick several days in St. Louis before applying at the Doctor's office. After a visit or two, he was treated at his temporary residence, the American hotel, on the corner of Sixth and Morgan streets. The man spoke English very imperfectly, and it was not possible to extract from him a clear history of his case. When first seen, there was some nausea, no jaundice, nor any during his sickness, which lasted altogether about two weeks. Towards the sixth day, he seemed to improve, but a day or so after that got worse; hemorrhage set in and he sank. After death the body was seen to be jaundiced.

Dr. O'R. also saw a lady from New Orleans, who had been taken sick on the way up from that city, by train, as a refugee. She was a native of Indiana. Her attack came on without a chill, but with high fever, accompanied with much irritability of stomach, and great pain in the back, with some headache. Pulse from 120 to 126. This lady, it must be stated, was addicted to the use of opium and arsenic. She had been some years a resident of New Orleans. On the second day of the Doctor's attendance, about 4 P. M., the fever had abated considerably, and her general condition was notably improved. The urine had been suppressed, at least partially, but she now passed water, and did so thenceforth freely enough. She never had any chill, but experienced chilly sensations from time to time. The bowels had been constipated. The nausea was constant, but she did not vomit much. There was no appearance of jaundice. Towards the fourth day, her condition was very much improved. She was not, however, fairly convalescent, and, indeed, had a slight relapse, from which, however, she eventually recovered, leaving the city as soon as she was able to get up, having been sick, altogether, eight days. The treatment was by mild aperients and diaphoretics. Quinine was given later. Opium was avoided altogether.

DR. CHARLES H. HUGHES, 1313 Chouteau avenue, states that on September 25, 1878, he was called to see and continued to visit, up to the 30th, Mr. Eugene Harrington, æt. 20, at No. 1550 Chouteau avenue, recently (within two weeks) from Mobile, Ala., where the yellow fever was then prevailing. On the first visit there was noticed general depression, fever, yellowishness of the skin and conjunctiva, and vomiting of dark grumous matter, with headache and delirium. There was also looseness of the bowels, and the amount of urine voided was somewhat below what is normal, viz., 24 ounces in 24 hours. The patient had never had malarial fever, and had had no chills; nor had he ever before been jaundiced, nor subject to bilious derangement. There was no hepatic enlargement, but epigastric tenderness was marked. Pulse rapid and small, fully 120 beats to the minute. His tongue was covered with a yellowish white fur, and thickened, so that dental impressions were marked.

The conclusion of the Doctor with regard to the case was that, taking into consideration its symptoms and history, the patient having, probably, been recently exposed either at home or in transit from the South, it was a case of yellow fever. The patient was treated with drop doses of carbolic acid in peppermint water, repeated every two hours until vomiting ceased. The vomiting was controlled by the following morning, and the carbolic acid continued in drop doses, three times a day, until the close of the case. Forty grains of quinine, in gelatine-coated capsules, were given every 24 hours, in four equal doses. Chloroform liniment was applied frequently and liberally, with the hand, over the epigastrium the whole length of the spine. Ether lotions were applied to the top of the head, and fanned away whenever there was pain in the head or delirium. During the first 24 hours of treatment, ten grains of calomel were given in divided doses. About the third day it became necessary to give citrate of magnesia to open the bowels.

Dr. Hughes states that his percentage of malarial cases during the summer and fall was not unusually large, but thinks it due to the high and healthy location of the neighborhoods in which most of his practice lies, the streets being all paved, and there having been no fresh excavations. With regard to yellow fever, Dr. Hughes thinks it due to a specific poison engrafted upon a typho-malarial condition. His patient made a good recovery.

DR. H. WICHMAN, 1417 South Seventh St., reports a case of yellow fever as follows (one of the three or four admitted into City Hospital in August):

J. Koenig, born in America, about 28 years of age, had been working at the Jetties at Port Eads, and was one of a band of ten or twelve who left that point for their homes in St. Louis when the fever broke out, arriving in this city on the 10th of August, 1878. He continued apparently well for two days, and was taken sick on the 12th, in the morning. He had no chill, but a fever came on insidiously, which soon ran very high. There was already some jaundice about the eye when Dr. W. first saw him, but not as yet on the body. Great lassitude was noted, pains in the back; nausea, but no vomiting, and no delirium.

Dr. Wishman saw no extension from the case. After his arrival the patient remained, for the two days above referred to before being attacked, on Duncan's Island, a very low and unhygienic locality. All those who were about him, remained well.

DR. J. FRIEDMAN, 7th St. between Elm and Myrtle, was in charge of the ward at the City Hospital set apart for cases of yellow fever, before the opening of the Quarantine Hospital below this city, on the river. While in charge of the ward a patient named Isaac Baer or Behr, from Vicksburg, put up at the Laclede Hotel, and was treated there for a short time by several physicians. When the case was recognized to be one of yellow fever the patient was sent to this ward in the City Hospital and attended by Dr. Friedman, as interne. There had been a case in the female wards of the Hospital in a patient named Louise ——, where a diagnosis was not made of yellow fever, but on autopsy, for she died, the characteristic appearances of yellow fever were observed, such as genuine black vomit in the stomach and intestines, etc. There was no propagation of the disease from her. Dr. Friedman was in daily attendance upon Baer, and during his illness, viz., on Aug. 17th, another yellow fever case, viz., that of J. Koenig, just detailed, was admitted into the ward. The patient Baer was nursed by J. Becker, who took yellow fever from him within a few days and died with black vomit. The urine was intensely colored, but normal in other respects for the first three days. The temperature varied between 103° and 104° and pulse was about 120. On the fourth day the temperature decreased to 101°, and the pulse to 108 or 110. There was still no nausea: the urine was scanty, and was now first observed to be albuminous. The bowels remained costive. There were no hemorrhages nor black vomit, but the skin became dusky, and the patient semi-comatose; on the fifth day, the skin was relaxed, and there was profuse, even colliquative perspiration. At the time the temperature was subnormal.

On the sixth day, he was seen by Dr. Spiegelhalter, a member of the Board of Health, and was transported on August 17th to the City Hospital, where he died that night.

DR. EDWARD EVERS, 1737 North Market street, states that he was at Quarantine during the season, as one of the assistant physicians. He there saw a great many cases of yellow fever, but no distinct case of yellow fever in the city of St. Louis. Dr. Evers has seen a greater number of cases of malarial fever this year than in any previous one in the last seven years. Many of these cases occurred in children, and began with convulsions. There were two deaths, a child aged one year, and a boy ten years old, of typho-malarial fever. In most of these cases there was marked congestion. In more than a fifth of the cases there was very pronounced yellowness of the skin and conjunctivæ, so great in some of the cases that Dr. Evers was often asked whether the attack was not one of jaundice. Some of the cases had suppression of urine. In one, there was profuse epistaxis, but in none of the other cases was there any hemorrhage. Most of these cases were seen between the 8th of August and the 10th of October, and were extraordinarily severe. The chills were very heavy, often lasting two or three hours, and generally accompanied with delirium. There was no albuminuria in several cases where the urine was tested.

DR. S. L. NIDELET, 904 North Fifth street, states that he saw no cases of yellow fever in the summer of 1878 in St. Louis, being absent from the city until the 23d of September; but from that date until cold weather he treated a large number of malarial cases. In his opinion malarial affections were more prevalent than he had known them to be for eight years. These cases were difficult to treat, and very rebellious. They were marked by gastric irritability and a disposition in the fever to assume a continuous type. They required larger doses of quinine than usual, and the use of arsenic afterwards. The chills were not generally well marked, often absent; in this respect the cases, in some instances, partook of a pernicious character. Since last season, all through the winter, Dr. Nidelet has observed a disposition on the part of many disorders to become complicated with malarial symptoms. In all these statements Dr. J. C. Nidelet fully concurs.

A TABLE SHOWING THE PRINCIPAL FACTS OF THE FOREGOING THIRTY-FIVE CASES OF YELLOW FEVER DEVELOPED IN PERSONS COMING FROM CITIES WHERE THE DISEASE WAS PREVALENT.

No.	Name.	Age.	Sex.	Color.	Nativity.	Residence in St. Louis.	Residence at the South.	Attending Physician	Date of 1st visit	Duration of illness	Termination.
1	Madison Castleman.	34	Male.	Mulatto.	America.	1104 North 10th St.	Lower River Str.	J. M. Clopton.	July 8	12 days	Died
2	W. P. O'Bannon...	16	Male.	White.	St. Louis.	....	St. Louis	Lankford & Bauduy.	July 16	5 days	Died.
3	Wm. Johnson.......	28	Male.	Mulatto.	United States.	1023 Morgan St.	Lower River Str.	J. M. Clopton.	Aug. 9	3 days	Died.
4	W. S. Nelson	60	Male.	White.	America.	604 North 23d St.	Port Eads.	F. V. L. Brokaw.	Aug. 10	7 days	Died.
5	Mrs. W. ———	..	Fem.	White.	....	....	Port Eads	G. C. Pitzer.	Aug. 12	14 days	Recovered.
6	E. Nelson............	45	Male.	White.	United States.	11th St. bet. Brooklyn & Webster	Port Eads.	J. M. Scott.	Aug. 10	5 days	Died.
7	H. Holland	..	Male.	White.	United States.	602 South 2d St.	Port Eads.	A. Luleff.	Aug. 11	6 days	Died.
8	J. Koenig...........	28	Male.	White.	United States.	City Hospital.	Port Eads.	H. Wichman.	Aug. 12	5 days	Died.
9	Mrs. W.'s child.....	..	......	White.	United States.	....	Port Eads.	G. C. Pitzer.	Aug. 15	— days	Recovered.
10	Louise ———.......	..	Fem.	White.	....	City Hospital.	The South.	D. V. Dean.	Aug. 15	— days	Died.
11	David Matthews	21	Male.	White.	....	....	Port Eads.	J. T. Pirtle.	Aug. 15	4 days	Died.
12	Isaac Baer...........	..	Male.	White.	Germany.	City Hospital.	Vicksburg.	D. V. Dean.	Aug. 17	6-[illegible] days	Died.
13	Mary Dorfina........	18	Fem.	White.	Italy.	Corner 10th and St. Charles Sts.	Columbus, Ky.	H. H. Mudd.	Aug. 20	4 days	Died.
14	Mrs. Nichols	25	Fem.	White.	....	....	Vicksburg.	W. M. McPheeters.	Aug. 22	7 days	Recovered.
15	Mrs. K	..	Fem.	White.	....	3413 Market St.	Port Eads.	G. C. Pitzer.	Aug. 22	-14 days	Recovered.
16	——— Nichols	26	Male.	Mulatto.	United States.	417 North 8th St.	Lower River Str.	H. H. Mudd.	Aug. 23	14 days	Died
17	————	30	Male.	White.	....	St. Louis Mullanphy Hospital.	The South.	E. H. Gregory.	Aug. 24	6 days	Died.
18	Mrs. Fryer.........	3[illegible]	Fem.	White.	....	....	New Orleans.	E. A. DeCailhol.	Aug. 26	[illegible] days	Recovered.
19	J. Stewart...........	50	Male.	White.	State of N. Y	1014 North 16th St.	Memphis.	G. H. Conzelman.	Aug. 26	8 weeks	Recovered.
20	Edward Coles.......	32	Male.	White.	....	Corner 7th and Morgan Sts.	Lower River Str.	J. M. Clopton.	Aug. 27	7 days	Recovered.
21	Mrs. Freiburg.......	50	Fem.	White.	France.	Laclede Hotel.	New Orleans.	P. F. Weigel.	Aug. 28	9 days	Recovered.
22	Valle Rozier	..	Male.	White.	New Orleans.	1210 Washington Ave.	New Orleans.	J. T. Hodgen.	Aug. 28	10 days	Recovered.
23	Mary Gardner.......	..	Fem.	White.	St. Louis.	....	New Orleans.	Dr. Heitzig.	Aug. 28	7 days	Died.
24	Sidney Ellis.........	7	Male.	White.	....	....	New Orleans.	F. V. L. Brokaw.	Aug. 31	— days	Recovered.
25	Geyer Small.........	20	Male.	White.	St. Louis.	....	Lower River Str.	W. M. McPheeters.	Aug. 31	12 days	Died.
26	———.........	35	Male.	White.	....	....	Memphis.	Dr. Newell.	Sept. 1	14 days	Recovered.
27	M—— C——	17	Male.	White.	....	——— Hotel.	The South.	W. Coles.	Sept. 3	6-10 days	Recovered.
28	——— ———.......	..	Male.	Mulatto.	....	810 Christy Ave.	Mississippi.	J. M. Clopton.	Sept. 2	6-8 days	Recovered.
29	E. C. Rathburn	42	Male.	White.	....	Steamer City of Alton.	Lower Riv. & N. O.	W. Wyman.	Sept. 2	6 days	Died.
30	——— Nelson......	..	Male.	White.	....	....	Vicksburg.	P. G. Robinson.	Sept. 6	3 days	Died.
31	——— W———.......	6	Male.	White.	Tennessee.	....	Memphis.	B. Roemer.	Sept. 7	3 days	Died.
32	——— ———........	35	Male.	White.	....	....	Brownsville, Tenn	H. H. Mudd.	Sept. 10	4-5 weeks	Recovered.
33	——— ———........	40	Male.	White.	Italy.	Corner 6th and Morgan Sts.	Memphis.	R. J. O'Reilly.	Sept. 15	8 days	Died.
34	——— ———........	..	Fem.	White.	Indiana.	....	New Orleans.	R. J. O'Reilly.	Sept. —	8 days	Recovered.
35	Eugene Harrington.	2[illegible]	Male.	White.	....	1550 Chouteau Ave.	Mobile.	C. H. Hughes.	Sept. 25	6-8 days	Recovered.

Of these 35 patients, 16 recovered and 19 died,—a mortality of 54.3 per cent.

In only three of the cases was any propagation observable, viz.:

(1.) In the case of Isaac Baer, from whom J. Becker, nurse at the City Hospital, contracted the disease.

(2.) In that of Nelson, from Port Eads, attended by Dr. J. M. Scott, where his nephew, Austin Walsh, whose case will be detailed, contracted yellow fever by visiting the room in which Nelson died.

(3.) In the case of Mrs. W.'s child, attended by Dr. Roemer, where the girl who nursed the child was taken with yellow fever a few days afterwards, and died of it at Quarantine.

A number of other cases where the disease was contracted by residents of St. Louis will be mentioned, but they do not properly fall into this category.

It must be recollected that all of these patients were sick in the heart of the city, at private residences, hotels, and a few at the hospitals; but in three cases only was the disease conveyed to others. This shows either a limited infecting power, or more probably, a lack of predisposition or receptivity in the overwhelming majority of persons attending upon the sick.

The mortality of these cases was no greater than that in Memphis or Vicksburg during 1878, in unacclimated or partly acclimated persons, a class to which most of the patients belonged. With but few exceptions they had all been sick one or two days before receiving medical attendance.

Considering the large number of persons who came to the city as refugees from the fever, the proportion of cases reported among them must be regarded as quite small. It is hardly to be doubted that by leaving the South, an impending attack was, in many instances, averted, or its intensity, when occurring, mitigated.

All of these cases terminated in the city; none of them were removed from their residences, except the five hospital patients. None at all were sent to Quarantine. They represent the class of patients allowed to remain at their lodgings or residences by the Health Department, where careful attention and isolation was possible. Some of the patients were too ill to move, and a considerable proportion were already sick when they arrived in St. Louis, and it is probable that a certain number were not reported at the Health Office.

SECTION II.

CASES OF YELLOW FEVER TREATED AT THE QUARANTINE HOSPITAL.

The Health Commissioner, Mr. C. W. Francis, gives the following statement of matters relating to the public health, and to the measures carried into effect to prevent the extension of cases of yellow fever developed in the city of St. Louis, or arriving already sick from Southern points.

In the early part of the summer, viz., before the 1st of July, the streets were in bad condition. A great deal of mud and dirt had accumulated in the gutter, in which grass and weeds had grown at many points. The surface drainage was thus clogged, and many of the drains smelt badly. An appropriation for cleaning the city was voted only late in July, but the street commissioners, even before the appropriation was received, put a force of men to work, and the city was then thoroughly cleaned up. About this time, he had a good deal of trouble in North St. Louis about back water from the Harrison street sewer. An opening existed into an area of unimproved lots of considerable extent, upon which people had been dumping garbage during the winter and spring, owing to the fact that they could not reach the Harrison street dump. A distillery, also, near by discharged its refuse material into this open space. The rain-water and back-water from the river overflowed all this area, making a black mud which emitted a fearful stench. This was about the middle of July.

About North Market street, there was another area of the same kind, viz., Exchange Square, covering an extent of 12.86 acres, without houses upon it. North Market street runs right through the square, whose level was unusually low. A portion of this space was a foul pond, on whose edges garbage had been dumped. The area of this pond was nearly four acres. Previous connection with the river having been made by sewer pipes leading into the main, barrels of sulphate of iron were rolled into the pond, and large quantities of gas lime also thrown into it. Some three hundred barrels of copperas were thus used. By these measures, the nuisances were abated by the end of July. The effect of the copperas was wonderful. *Nearly all the men engaged in this work at Harrison*

Street and Exchange Square fell sick with fever or diarrhœa, and one or two of them died.

A very bad smell was also noticeable about the Vinegar Factory, between Spruce, Walnut, Third and Fifth streets, which indeed could be perceived as far up as Chestnut street. This was traced to a sewer, into which the scum from the vinegar works was discharged. The sewer was flushed out, and further discharge of scum into it forbidden, and the refuse of the works was ordered to be hauled away.

During the remainder of the season, copperas in large quantities was purchased and turned over to the sewer department. Their men, paid by the Health Department, went about and placed the copperas in the sewers in the solid form.

The city was not as well prepared last summer to meet the invasion of an epidemic as it should be. Perhaps the location of the Quarantine establishment, fifteen miles below the city, on the bank of the Mississippi, is not as good as it might be, or altogether unobjectionable. The buildings need repair, and facilities for bathing should be afforded.

When the yellow fever first made its appearance in the South, the Health Commissioner began to feel apprehensive with regard to this city. In conversation with medical members of the Board of Health and other physicians, it was generally assumed that yellow fever could not propagate itself in St. Louis, and this was likewise the general tone of public sentiment. Under such an assumption, stringent quarantine regulations tended only to the disadvantage of the commercial interests of the city. Those who maintained this view based it upon the facts that, up to 1878, yellow fever had never appeared in St. Louis; that the city lies to the north of the limits of the yellow fever zone; and that the contagiousness of the disease, and its ability to propagate itself in this latitude, were not as yet evident or supposable.

Traffic with the South still continuing, and many persons arriving in St. Louis sick of yellow fever, or becoming so within a few days after their arrival, the Health Commissioner soon found himself in a trying and very responsible position. Its difficulties were enhanced, before long, in a vexatious way, by the reception of numerous dispatches from the South, viz., from Western Louisiana, Texas, and Arkansas, constantly referring to the alleged existence of yellow fever in St. Louis, and threat-

ening to interrupt all commercial communications if the fever should be found to be really present in St. Louis, in spite of representations to the contrary. Any attempt to prevent the introduction of the fever into the city by the enforcement of severe quarantine restrictions would perhaps alarm the people of the Southern States, who might thence infer that the disease was either already present in the city, or reasonably apprehended by its citizens, and it might, therefore, be taken for granted, at the South, that St. Louis admitted her liability to the disease by such action. The tenor of these dispatches was a persistent unwillingness to believe that there was no yellow fever in St. Louis. On the other hand, the Health Commissioner was himself apprehensive that if stringent measures of prevention were not promptly adopted, the fever might actually take root in the city. Such few cases as had up to that time been developed in persons coming from cities where the disease prevailed, had been sent to the City Hospital, where special accommodation was provided for them, a course which did not at first excite any opposition. Very soon, however, public opinion declared itself in the opposite direction, and the residents near the City Hospital threatened to hold indignation meetings if any more patients of the sort were sent to that institution, which is located in the heart of the city. Early in August, in view of these facts, the Health Commissioner determined that it would be necessary to put the Quarantine establishment in order, looking to the detention there of persons arriving by steamers from the South, already sick, and the accommodation of those who should be attacked in St. Louis with the disease after their arrival, who would in future be conveyed thither promptly. He accordingly went down to Quarantine in company with Dr. H. C. Davis, whom he appointed physician in charge, and ordered that the institution be made ready at once for the reception of patients.

At the same time he placed physicians on the Iron Mountain railroad, at Belmont, and on the Cairo Short-Line railroad, and also on the St. Louis & Little Rock railroad. On the 10th of August, orders were given that all boats coming up the river should be stopped and inspected, and that all sick found on them should be taken off and carried on shore into the Quarantine Hospitals. The physicians on duty on the railways were ordered to have any sick they might find similarly disposed of. This was thought enough at the time.

About the 2d of September, after conferences with the Board of Health, the Health Commissioner began to feel still more solicitous on this subject, and it was thought advisable to remove all persons known to be sick of yellow fever in the city of St. Louis, having been attacked here after their arrival from the South, as well as those whose symptoms were suspicious, after undoubted exposure to yellow fever, by the quickest and easiest route, to Quarantine also. Many persons were now arriving, refugees from infected localities, and a good share of these were taken sick after a longer or shorter period of time, many of them dying. An inspecting service under the control of the Health Department was therefore instituted, by which physicians were posted at all the police stations, so that they might be within immediate reach of any suspicious cases reported at the station by the police, which it was their duty at once to visit, diagnose, and report upon by telegraph to the Health Office. Arrangements were made at the same time with the police authorities, according to which a daily report was sent in to the Health Office by the Captain commanding that district of the city, giving all information relative to sickness in the district, and also stating what the inspecting physician had found it necessary to do, and other matter of interest with regard to the public health. Full information, consequently, within twenty-four hours, was always at hand at the Health Office, as a basis for prompt action concerning persons sick with yellow fever, or reasonably supposed to be so, already in the city or arriving on railroad trains, as well as for the speedy investigation of nuisances and their abatement as soon as possible. Eight medical men, as the Inspecting Officers referred to, were thus placed on duty in St. Louis and Carondelet. When cases of yellow fever were reported by telegraph to the Central Office by any of this corps, they were, in most cases, promptly sent down to Quarantine; but a certain amount of latitude was permitted where the patient could be well attended and securely *isolated*. There was an absence of any positive law authorizing the removal of the sick, and the Health Commissioner was obliged to stretch his prerogatives, in many cases, beyond the limits of his actual power, in view of the general welfare. There never was any absolute declaration of quarantine for the City of St. Louis in 1878 by the Board of Health, but orders of the Health Commissioner, approved by the Board, were issued to the railway and steamer companies with regard to

freight. It was ordered that sleeping cars should be switched off at Belmont, and their passengers transferred, so that no sleeping car should arrive in St. Louis directly from the South. The steamers were stopped at Quarantine, inspected and fumigated. At first they were detained only a few hours, but after the epidemic had culminated the boats were detained from one to two weeks, the freight removed, and the vessel thoroughly disinfected. Some boats, e. g., the *City of Vicksburg,* were not allowed to come up to the city at all. All barges arriving were also fumigated.

As it had been determined to send no more patients sick of yellow fever to the City Hospital, notably after the death of one Becker (a nurse who contracted the disease from a patient named Baer, whose case had terminated fatally), and in compliance with the opinions expressed by the physicians in charge of the institution and the citizens residing in its neighborhood, it became necessary to provide an early and prompt mode of transportation for the sick from the city to the Quarantine establishment, and one, moreover which would be exclusively under the control of the Health Commissioner, and ready for service at any hour of the day or night. With these views, about the 23d of August, the steamer Edwardsville, formerly a ferry boat running between St. Louis and East St. Louis, was hired, with her crew, from the Wiggins Ferry Company. The crew consisted of two pilots or captains, two engineers, a cook and three deck hands. A physician and nurse were on board at all times. The sick were taken from their residences in various parts of the city and driven on board the steamer, where they were removed from the ambulances, (within three feet of the door of the cook's kitchen; the cook took yellow fever and died of it later,) and carried up a stairway into the cabin of the boat which had been arranged and furnished as a small ward. One of the two men put on as pilot left, and was succeeded by another, (Miller) as an aid to Wm. Conley, who died of yellow fever later in the season. The cook was on duty day and night, and so were the engineers, neither of whom were taken sick. The boat was kept busy all the season, and constantly in readiness to start, but was not allowed to remain at Quarantine over night, except when caught in fogs, so that she could not get away. She was an old boat full of cracks. The floor of the cabin, now a sick ward, was covered with oil cloth. Early in the season the hold of the ves-

sel was cleaned out, fresh water being pumped in and carbolic acid used liberally. When a man was brought down in an ambulance, he was taken up stairs and put to bed and the bedding on which he was brought down, if any, was taken out of the ambulance and burned on the wharf. When he reached Quarantine, the sheets, pillow-cases, and coverlets of the bed on which he lay while in transit were taken off and left at Quarantine to be washed, the patient himself being placed in a ward devoted either to yellow fever or to malarial fevers. On the return trip of the boat, the cabin was closed, all utensils cleaned and disinfected, and chlorine liberated in the ward itself. Towards the 8th of October the boat began to show that she was infected, by the occurrence of several cases of very malignant yellow fever in her captain and crew. (These cases are elsewhere detailed.) All these cases occurred within a few days of each other. When it was found that the steamer had become so badly infected, she was at once put out of commission and laid by, not being used after the death of the nurse, Kettlekamp. On October 19th she was returned to the Wiggins Ferry Company, but tied up at Quarantine; she was not allowed to come to the city. After this, patients were sent down in ambulances. Every part of the steamer was thoroughly cleaned and disinfected after the outbreak of the yellow fever among the crew. The hold was at no time offensive; the engineer was often in the hold when he suspected the boat might be leaking; he was not attacked with yellow fever.

There was a great disposition among the nurses and attendants at Quarantine to fall sick; *almost all who were sent down there, were taken sick after a week or two with hybrid forms of fever, which, if not yellow fever, seemed to be something very like it.* This disposition was observable from the 1st of September until the close of the season. Such patients were treated in their own apartments and not in the wards. Some of the attendants upon patients sick of yellow fever in the stone house, (see plan of Quarantine) having become sick themselves, the stone house was vacated entirely of sick and well, and its occupants were transferred into other buildings hitherto unused.

The water used at Quarantine was pumped up from the river; no well-water or cistern-water was used. The general condition of the premises was good, and they were put into excellent order before occupation.

Under date of September 16th, Dr. Davis wrote a letter to the Health Commissioner calling attention to some defects in the sewerage at Quarantine, and noticing particularly the unhygienic conditions of the sewer leading from the kitchen to the river, and the fact that the sewer discharged its contents into the river about twenty-five feet below the orifice of the pipe through which water was pumped up for the general supply of the establishment. He described the condition of the sewer leading from the kitchen as very bad, indeed, in his opinion, seriously interfering with the health of employés and the prognosis of those sick. He suggested some plans of improvement, especially a discontinuance of the old sewer, and the digging of a new system of sewers to be made of tile. On examinination of the premises, it was found that a somewhat less elaborate system of improvement would rectify the defects complained of, and accordingly a ditch was dug leading from the privy west of the kitchen and obliquely round to the sewer ranging just north of the wards, and laid with eighteen-inch tile. The privy was also remodelled so as to allow the rain water from the shed of the brick house and the slops from the kitchen to pass through it and keep it well washed out. This work was all finished on October 5th. One of the men, the engineer, Richard McDonough, did a great deal of the bricklaying in the privy-vault, and was afterwards sick for some weeks. Dr. Davis superintended this work, and saw a great deal of it done.

At the Small-pox Hospital, also, just half-a-mile west of the Quarantine grounds, there was an offensive privy, without drainage. Dr. Davis was a good deal about this privy, and superintendent the work of filling it up and digging a new one connecting with a neighboring sink-hole.

On the 2d of September, Dr. Davis wrote to the Health Commissioner that he feared a stampede among his employes, since the news had become public about Becker's (the nurse who had contracted yellow fever and died while attending a patient) death at the City Hospital. He stated that many of his men were sick, and that he had had disinfectants freely used, and advocated direct communication with the health office through a wire leading to the line of the Western Union Telegraph company.

The Health Commissioner stated that the general method of dealing with steamers arriving from the South, was as follows:

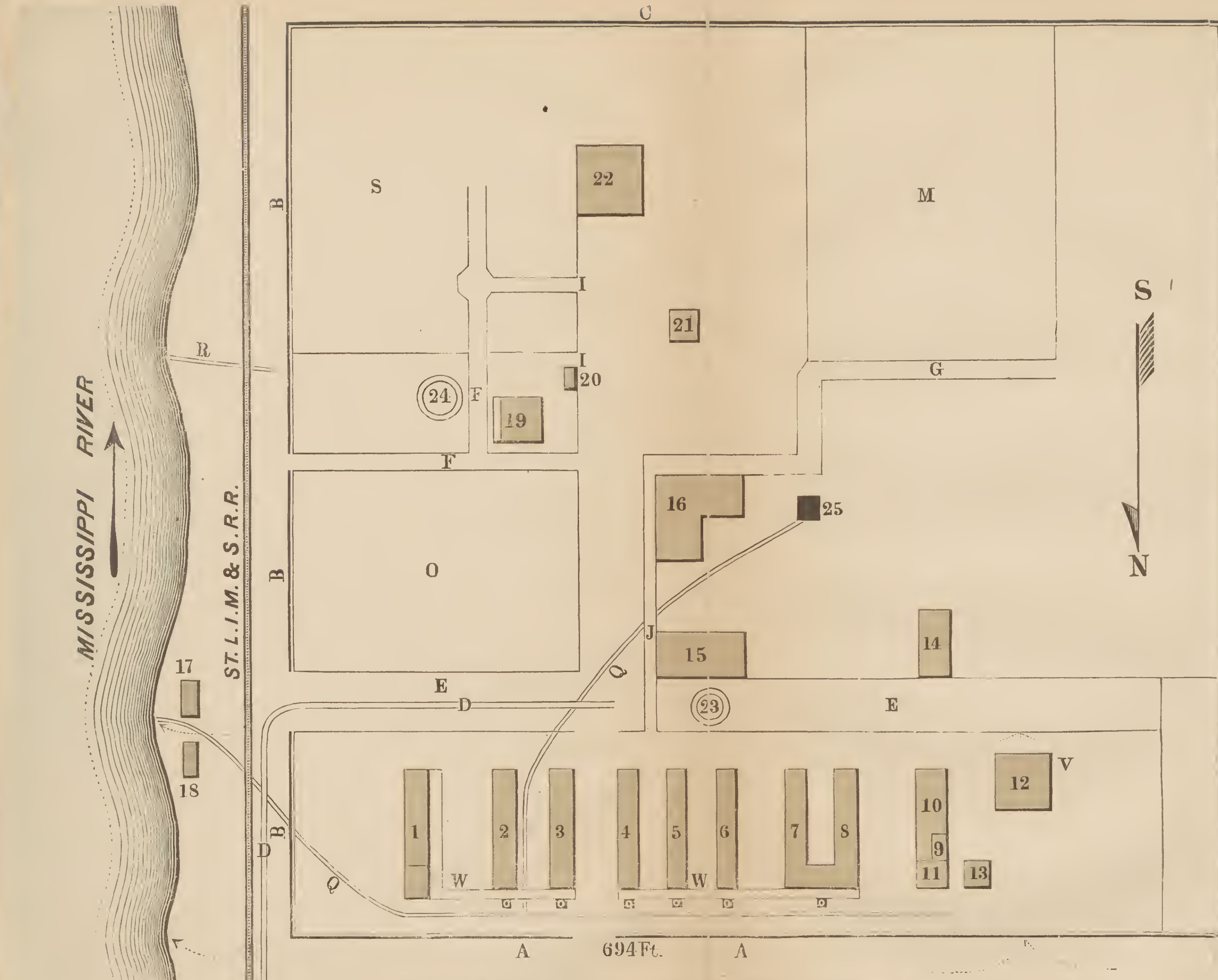
They were notified by the firing of a gun under charge of a squad of policemen, that they were desired to stop at the landing as they came up, night or day. An inspection of the passengers and crew was then made all through, and patients found sick with yellow fever, or any grave form of fever, sent ashore to remain for treatment. The vessel was next thoroughly fumigated, in the hold, on the main deck, and in her cabins, with sulphurous acid, and chlorine mostly. The passengers were crowded on the guards while this was done, but the corps of physicians suffered greatly on these occasions. After this had been done, the boat was in most cases detained for a week or two, sometimes on the same side, or right bank of the river, but on most occasions, on the opposite shore. If after the expiration of this period of time, no new cases of fever were developed, the boat was allowed to proceed on her way to St. Louis. Some of the steamers so detained were not allowed to come up to the city until the close of the season.

The trains on the Iron Mountain railroad were boarded by traveling medical inspectors, one of whom went as far as Poplar Bluff, and the other to Belmont. On the Cairo Short Line railroad, the inspectors traveled between St. Louis and Belleville, Ill. The other roads were duly watched by the police and the inspecting physicians for the city.

The Health Commissioner states it as his opinion, that the experience of the past year, has shown that the steamer Edwardsville and some of the wards at Quarantine, became at the last thoroughly infectious, so much so, that towards the close of the season, it was almost certain that any new-comer, especially if already sick of some febrile disorder, would become ill of yellow fever and perhaps die. The fact that the steamers were detained opposite the Quarantine establishment, some half a mile away, may have had much to do with this. It is the purpose of the Health Commissioner to put the establishment at Quarantine in perfect order early this (1879) season, so as to be ready for contingencies, and to avoid the necessity of disturbing existing arrangements during the summer. New wards are now in process of construction on the hill top, the old ones used last summer having been purposely destroyed by fire.

We append the following extract from the records of the Health Department, and a plat of the grounds and Buildings at Quarantine, furnished to the committee by the Health Commissioner:

P ATE I.



A, B, C, Boundary lines.

D, E, F, G, Paths and roadways.

Q, R, Drains.

S, M, O, Open grounds, orchards and gardens.

V, Water reservoir. (This is now disused; a new one having been constructed on the hill-top.)

1, 2, 3, 4, 5, 6, 7, 8, 10 and 15, Wards.

16, New brick house. (Steward's and attendants quarters.)

17, Pumping house.

18, Sheds.

19, Stone house.

20, Privy.

23 and 24, Fountains.

25, Privy: (drawn on the plan too far westward; its western side is really fifteen or twenty feet beyond the face of the L of the new brick house, (16).

14, Stable.

13, Privy.

W, Privies at the rear of each ward.

The grounds rise by a gentle ascent rom the river: westward.

The wards 1 to 10 inclusive were purposely burned, and new ones erected on the crest of the hill, in April, 1879.

PLAN OF THE ST. LOUIS QUARANTINE STATION, AS IT EXISTED IN 1878.

LIST OF ADMISSIONS AT QUARANTINE FROM AUGUST 18TH, TO NOVEMBER 12TH, 1878.

1878.	Date.	No. Admitted.	DIAGNOSIS.	Refugees.	Local.	Quarantined.	Discharged.	Died: from Yellow Fever.	Died; from Other Causes.
Aug.	18	2	Intermittent Fever	2					
	19	1	Intermittent Fever	1					
	20						1		
	21	1	Yellow Fever	1					
	22							1	
	25	2	Yellow Fever	2					
	25	1	Intermittent Fever	1					
	26	3	Yellow Fever	3					
	27	3	Yellow Fever	3				1	
	28	2	Intermittent Fever	2					
	28	1	Remittent Fever	1					
	28	7	Yellow Fever	7				1	
	30	6	Yellow Fever	6					
	30	1	Yellow Fever	1		1			
	30	1	Pregnancy	1					
	30	1	Intermittent Fever	1				1	
	31	3	Yellow Fever	3			4	2	
Sept.	1							1	
	2	2	Yellow Fever	2					
	2	1	Intermittent Fever	1					
	3	3	Yellow Fever	3			4	2	
	3	1	Intermittent Fever	1					
	4	2	Yellow Fever	2					
	4	1	Bronchitis	1					
	4	2	Intermittent Fever	2			1	3	
	5	1	Intermittent Fever	1					
	5	3	Yellow Fever	3					
	6	3	Yellow Fever	3					
	6	2	Yellow Fever	2		2	2	1	
	7	3	Yellow Fever	3			1		
	7	1	Intermittent Fever	1			2	1	
	8	1	Yellow Fever	1			1	1	
	9	3	Yellow Fever	3			1	1	
	10	1	Intermittent Fever	1					
	10	2		2		2			
	10	2	Yellow Fever	2			7	1	
	11	2	Yellow Fever	2					
	11	1	Intermittent Fever	1				1	
	12	1	Yellow Fever	1			3	1	
	13	1	Heart Disease	1					
	13	3	Yellow Fever	3			3		
	14	1	Yellow Fever	1					
	14	1	Intermittent Fever,	1			3	1	
	15	1	Intermittent Fever	1					
	15	4	Yellow Fever	4			5	2	
	17	2	Intermittent Fever	2					
	17	1	Yellow Fever	1			6		
	18	1	Yellow Fever	1			3	1	
	19							2	
	21	2	Yellow Fever	2					
	21	1	Chronic Dysentery	1			6		
	23								1
	24	1	Yellow Fever	1					
	25	2	Yellow Fever	2					
	25	1	Intermittent Fever	1			2	1	
	27	2	Yellow Fever	2					
	27	1	Intermittent Fever	1					
	28	1	Yellow Fever	1					
	29	2	Yellow Fever	2			1	1	
	30						5		
Oct.	2	1	Yellow Fever	1			1		
	3	3	Yellow Fever	3					
	4	1	Yellow Fever		1		1	1	
	5	1	Intermittent Fever	1					
	6	1			1				

LIST OF ADMISSIONS AT QUARANTINE FROM AUGUST 18TH TO NOVEMBER 12TH, 1878—CONTINUED.

1878.	Date.	No. Admitted.	Diagnosis.	Refugees.	Local.	Quarantined.	Discharged.	Died: from Yellow Fever.	Died from Other Causes.
Oct.	7	1	Yellow Fever	1			2		
	8	1	Yellow Fever	1			1	1	
	9	2	Yellow Fever	1	1				
	10	1	Yellow Fever		1				
	10	2	Yellow Fever	2			2	1	
	11	..					1		
	12	1	Yellow Fever	1					
	13	1	Yellow Fever		1		1		
	14	2	Yellow Fever		2		3	1	
	15	2	Intermittent Fever	2				1	
	15	5		5		5			
	15	2	Yellow Fever	1	1		1		
	16	1	Yellow Fever	1			8	2	
	17	4	Yellow Fever	3	1		1	1	
	18	..					1	1	
	19	..						1	
	20	1	Pneumonia	1			1		1
	21	..					1		
	22	1	Yellow Fever		1		1	1	
	26	..					1		
	30	..					1		
	31	..					2		
Nov.	5	..					2		
	12	..					2		
Totals		135		125	10	10	95	38	2

SUMMARY OF TABLE.

Total Number of Cases Admitted	135	Died.. 40	Discharged.. 95
Number Cases Yellow Fever (including Thurliss and Niemeyer)	97	" ..38	" ..59
Number Cases of Intermitent Fever	24	" .. 2	" ..22
Number Cases of Remittent Fever	1	" .. 0	" .. 1
Number of Other Diseases and not Diagnosed	13	" .. 2	" ..11

No. of Cases Admitted.	Yellow Fever.	Intermittent & Remittent Fe'r.s	Total Fevers.
From Aug. 18th. to 24th	1	3	4
From Aug. 25th to 31st	5	5	30
From Sept. 1st to 7th	18	6	24
From Sept 8th to 14th	13	3	16
From Sept. 15th to 21st	8	3	11
From Sept. 22d to 28th	6	2	8
From Sept. 29th to Oct. 5th	5	1	6
From Oct. 6th to 12th	8	0	8
From Oct. 13th to 19th	10	2	12
From Oct. 20th to 26th	1	0	1
From Oct. 27th to Nov. 2d	0	0	0
From Nov. 3d to 9th	0	0	0
From Nov. 10th to 12th	0	0	0
Total	95	25	120

Of these cases of yellow fever 85 were from Southern points; 10 cases were local, viz., originated either by contagion or by independent production in the city of St. Louis or its suburbs, the subjects being residents of this city and not having been in the South in the year 1878.

A DETAIL OF SOME CASES TREATED AT QUARANTINE.

The following detail of cases treated at Quarantine, will be of interest; the cases are included in the Quarantine list:

Dr. A. Hausmann, who was one of the medical officers of the Health department at Quarantine during the summer of 1878, contributes the history of six typical cases of yellow fever, to the *St. Louis Medical and Surgical Journal* for January, 1879, all coming from the South and treated at Quarantine.

Case I.—Chas. N——, æt 26, admitted Sept. 7th, says he did not feel well for the last ten days, but on the 3d of Sept. was taken with fever and pains in the lumbar regions. At present he only complains of tenderness in the stomach, but does not vomit; tongue coated in the middle, borders red; eyes slightly injected and a little yellow; temperature, 100.9°; pulse, 92. He died on the sixth day, not apparently having had black vomit or other hemorrhages, though he had frequent vomiting.

Case II.—W. I. W——, æt 26, left Memphis Sept. 4th. While on the train, about six hours before his arrival in St. Louis, he was suddenly seized with chills, fever, pains in his forehead and back. On the morning of the 5th he was sent to the hospital. There was much prostration, slow and unsteady gait, and apathetic drowsiness. Conjunctivæ much injected and distinctly yellow, and face flushed. Tongue coated with a dirty brown fur; great tenderness in the epigastric region. Albuminuria; temperature, 104°; pulse, 96 to 100. During the next two days, frequent vomiting, with aggravation of all the symptoms, except pulse and temperature, which were reduced to 102.5°, and 64°, on the morning of the 8th of September, when the first signs of black vomit appeared. Towards evening the temperature rose steadily, and at midnight reached 105°. Applications of cold sheets brought it down, but did not awake the patient from a deep stupor in which he died the next morning, the fifth day of his disease.

Case III.—P. M——, æt 35 years, fell sick on the 9th of Sept., with chills, but little fever, pains in the head and back, frequent

vomiting, and great weakness. First seen on Sept. 13th, temperature, 100°; pulse, 60 to 64. On examination, nothing abnormal was perceived, except some tenderness around the umbilical region. No injection or coloring of the eyes. While being examined, he suddenly complained of pains in his legs, and soon after vomited a liquid looking brown, from numerous dark membrane-like particles suspended in it.

The next morning the temperature was 100°; pulse, 68; had still some pain in the lumbar region, and vomited everything he took. Had not passed his urine. In the afternoon, a catheter was introduced, and about an ounce of urine obtained, which contained albumen in large quantity; temperature, 100°; pulse, 60; respiration, 24.

On the 15th, he was very restless and delirious towards evening, with cold extremities and moist skin. At 8 P. M., temperature 105°; pulse, 100, easily compressible. Respiration between 40 and 50. Died in profuse perspiration between 9 and 10 o'clock, on the seventh day of his sickness.

CASE IV.—C. H. F——, æt 25, admitted Sept. 15th from a boat; sick since the morning; pains in the lumbar region; tongue slightly coated; temperature, 101.5°; pulse, 88; slight frontal headache.

September 16th—Had slept well; had no pain; several passages during the night; urine free; no albuminuria; temperature, 102°; pulse, 88; tongue little more coated than the day before. At 10 A. M., the pains in the forehead and across his back returned more vehemently; coughing and deep respiration caused pain; temperature, 104.5°; pulse, 92. Vomited a dose of quinine.

September 17th—Temperature, 104°; pulse, 80; restless; tenderness around the umbilicus; no vomiting; urine a little turbid, containing much albumen. At 6 P. M., temperature, 104¾°; pulse, 76. At 7 P. M., he vomited a limpid fluid specked with blood.

September 18th—Temperature, 102 5°; pulse, 76; felt easier and slept much better than he did the night before; vomited twice, the liquid ejected being mixed with dark flakes; tenderness over the stomach; passed his water during the night; did not vomit during the day, and slept most of the time.

September 19th—Temperature, 102°; pulse, 96; had black vomit during the night, became unconscious toward morning, and died before noon on the fifth day.

CASE V.—W. B——, æt 28; admitted Sept 15th; taken from the same boat as case IV. Sick since 13th inst. with chills and fever, pains in the forehead and back; vomited after taking a dose of mustard; face red, flushed; eyes much injected, tongue coated; temperature, 102.5°; pulse, 92.

September 16th—Temperature, 103.2°; pulse, 76 to 80; respiration 24. Had several passages, and vomited frequently a limpid matter; slight pains only in the lumbar region; tenderness at the epigastrium unchanged; urine freely passed, contains albumen. In the evening, temperature, 103.3°; pulse, 80; increased pain in back and stomach.

September 17th—Very restless during the night, several stools, and frequent vomiting of fluid containing brown flakes and red particles of coagulated blood; eyes more injected; epigastric tenderness increased; great prostration, face pale and somewhat yellow; temperature, 103°; pulse, 80. In the evening, temperature and pulse the same; frequent vomiting of black matter, epistaxis and constant hiccough. Died the next day before noon, on the sixth day, retaining consciousness until a few hours before death.

CASE VI.—W. B., æt 21 years, admitted Sept. 7th; came from Memphis three weeks before on the Iron Mountain Railroad; has not been well since August 31st; dates his present illness from the 1st inst, when it began with pains in the forehead, stomach and back; at present, great tenderness in the epigastric region, dullness and enlargement of the liver, eyes injected and slightly yellow; tongue thickly coated; slight frontal headache; great prostration and drowsiness; no albuminuria; vomited three times to-day, the fluid ejected the last time containing a few particles of blood; constipation. Temperature, 101.9°; pulse, 80.

September 8th—Temperature, 104°; pulse, 100; frequent vomiting, but without blood. In the evening, temperature, 105°; pulse, 116; urine contains albumen and coloring matter of bile.

September 9th—Temperature, 102.5°; pulse, 92. Cold sheets applied.

September 10th—Temperature, 99°; pulse, 84; the next day the urine was free from albumen, and convalescence set in.

Besides these cases, Dr. Hausmann saw a number of others which did not materially differ from them, during the term of his connection with the Health Department.

SECTION III.

CASES OF YELLOW FEVER ARISING IN ST. LOUIS, ITS SUBURBS, AT QUARANTINE, AND ON BOARD THE QUARANTINE TRANSPORT STEAMER, BY CONTAGION FROM CASES DEVELOPED IN PERSONS FROM POINTS AT THE SOUTH WHERE YELLOW FEVER WAS EPIDEMIC.

The following are the notes taken at the City Hospital upon Becker's case, as forwarded by Dr. D. V. Dean, physician to the hospital:

"John Becker, æt. 53; a butcher; born in Germany; widower; residing at 1107 Salisbury street; was admitted on the 9th of March, 1878, and treated for pneumonia of the right lung. Having fully recovered, he was discharged on the 20th day of August. The day before he was given the position of nurse at hospital, taking charge of division 78A, in which the yellow fever cases were treated. On the night of the 20th of August, 1878, and until the 23rd, he nursed a patient who died, having yellow fever. The patient, viz., Isaac Baer (or Behr), was taken with yellow fever on coming from Vicksburg on the ——— day of August. John Becker continued in good health until the 26th day of August, when I was called and the patient complained of headache and fever. He was given cinchonidia under the supposition that he was affected with malaria. He continued having some fever; had pains in the back and an uneasiness of stomach. On the 29th his fever not improving, attention was called to his uneasy look and the congestion of his conjunctivæ. I also noticed some red spots on those parts of his body that were exposed. These points were small, very red, and had a white zone surrounding them; they were not raised above the skin. (These spots on the exposed part of the patient's body were doubtless mosquito-bites. In yellow fever, in consequence of the facility with which hemorrhagic transudation occurs through the vessels, mosquito-bites are very commonly followed by these punctiform hemorrhages. Of course like all other hemorrhagic phenomena they are of bad prognosis, and do not occur until the disease has lasted two or three days). On the fourth day the patient expressed himself as feeling easier; he vomited, however. Dr. Glasgow examined his urine on this day, and I did so

afterwards myself and found abundance of albumen. We both found bile pigment in his urine. His temperature this day was a little above 37.8 C. (=100° F.).

Aug. 30—Evening temperature, 37.70 C. (=99.8° F.).

Aug. 31, 9 A. M.—Temperature, 36. 5 C. (=97. 7° F.); pulse, 68; drew off his urine this morning and got only a tablespoonful. On examination I found the presence of albumen as well as bile-coloring matter; patient this morning is not quite as well as he was yesterday; complained of some tenderness over the stomach, and has made several attempts at vomiting. 12 M.—Temperature, 36.6 C. (=97.9° F.); pulse about normal. 4 P. M.—Patient decidedly worse; on giving him his medicine he vomited; the vomit was black and of the same character as the yellow fever vomit, as seen by the unaided eye, and as shown by the microscope. 5 P. M.—Patient dying; continues to vomit; died at 5:10 P. M.

On post mortem examination the stomach was found somewhat congested, and about one-fourth full of the black material he vomited; the liver pale in color and somewhat enlarged; spleen somewhat larger than normal and very black; kidneys of normal size; in the left kidney a small cyst was found. On examination of the black vomit found some disorganized blood corpuscles."

DR. J. FRIEDMAN, Seventh street between Elm and Myrtle, was in charge of the ward at the City Hospital set apart for cases of yellow fever before the opening of Quarantine Hospital, below this city on the river. Dr. Friedman had charge of the ward while the patient, Baer, whose case has already been sketched, was sick. Baer was the only case at the time in the ward. There had been a case in the female ward of the hospital, as has been stated, but not in the ward in which Baer lay, of a patient, Louise ———, supposed to be from the South, in which, however, no diagnosis of yellow fever was made during life; but on autopsy, genuine black vomit was found in the stomach and intestines, although the patient did not vomit black vomit. The nurse, Becker, who attended upon Baer, had nothing to do with Louise. Dr. Friedman was in daily attendance upon Baer, and during his illness on Aug 17th, another yellow fever case, viz., J. Koenig, whose case has been detailed, was admitted into the

ward. Becker was nursing Baer and the other patient likewise. Becker, the nurse, was taken sick with a chill, followed by fever three days after the death of Baer. Becker had had a double pneumonia some months before, but was apparently perfectly well while acting as nurse in the yellow fever ward; he did not drink, indeed, not having access to liquor in the hospital. Becker was acting as night-nurse in the yellow fever ward; the day-nurse in the same ward was not at all affected. Shortly after his chill Becker received a mercurial purge and took some cinchonidia; that evening he was quite sick but was supposed to be doing well; he was still walking about. Next morning he sent for Dr. Friedman, saying he did not feel as well as he had done the day before. At at 8 A. M. he still had fever, which *had not remitted*; this was the second day. On the same day small spots of petechial character were observed on the hand and exposed surfaces, (probably mosquito bites, which are nearly always productive of a punctiform extravasation of blood in yellow fever,) and uneasy feelings about the stomach began to be experienced; inappetence; nausea, but no vomiting; urine free, and an action by the bowel. The fever did not run very high, the pulse being 100; the patient complained of a painful feeling in the back. On the next day, (3d) Dr. P. G. Robinson was called in consultation. That evening there was partial suppresion, and some urine was drawn for purpose of diagnosis; it was found to contain albumen and biliary salts. On the fourth day Becker said he felt better, but towards evening he began to vomit glairy matters, containing bile. By degrees the vomited matter assumed the character of pure black vomit, although he did not vomit this in any great quantity. On post mortem the characteristic features of yellow fever were observed; the liver was of the well-known *café au lait* color; the uriniferous tubules were found stuffed with hyaline casts. The liver was examined microscopically by Dr. Dean.

Dr. Friedman has seen nearly two hundred and fifty cases of malarial fever in the City Hospital the past year. He thinks that the cases during the past summer were more than usually severe. In one case there were petechiæ and epistaxis. The prostration was very marked as a rule, and the disease less amenable to treatment than the same class of cases admitted into the hospital during the months of August and September in other years.

DR. T. O'REILLY, cor. Washington ave. and 18th St., states that in September, 1878, he was called to see a woman at 718 Christy Avenue. He found her with all the symptoms characteristic of yellow fever. Tongue dry and crusted with dark sordes; bowels moving occasonally with black dejections. Great irritability of stomach, and black vomit,; diffused yellowness of the skin and eyes. It was by all accounts the third or fourth day of her attack. She was semi-comatose when seen, with delirium. This woman had never been to the South, but the parties about her informed the Doctor that within a week or ten days she had been in relation and personal contact with several men from the South, and they expressed the suspicion that her disease originated by contact with them. The house is situated in a neighborhood of bad repute, but was, the doctor says, as far as he could observe, in good sanitary condition. That the case was one of yellow fever he did not doubt, nor that it orginated in this city. From the Health Office we learn that this woman was named Mollie Dillon, that she was sent to the Female Hospital on the 3d of September from 718 Christy Ave.; the diagnosis was "bilious remittent fever." She had never been to the South, and was born in the United States. Her age was 19 years. She recovered.

DR. W. HUTSON FORD, 2945 Gamble St., contributes the following case.

Austin Walsh, æt. 17, was working in a shoe-factory on the corner of Fifth St. and Christy Avenue, and slept at his home No. 1408 North Fourteenth Street. Had not been out of St. Louis, nor on board of any steamer or barge. During the hot weather of the early part of September, 1878, the boy slept upon a pallet which he laid down on the back-porch of the house in which his family occupied two rooms and a kitchen, on the ground-floor. Another family lived in a finished basement under them, and others still up-stairs in the second story. This porch opened directly upon the yard, which was walled in in all directions. In the yard, about forty to fifty feet from the porch, there are a couple of old-fashioned privies, without water communications, two stables, and a pile of manure, unsheltered from the sun, perhaps three or four cart-lords. The premises, not long before Walsh

was taken sick, became so offensive, that his mother complained to the landlord, desiring that he should have them cleaned, but unavailingly. Two weeks later, however, this was done. Austin Walsh was a nephew of Mr. E. Nelson, whose case of yellow fever is elsewhere spoken of. Nelson arrived sick of the disease in St. Louis, and was attended at his residence at 1133 North Eleventh St., by Dr. J. M. Scott. Dr. Ford saw him also in consultation with Dr. Scott. He was one of ten or twelve citizens of St. Louis who had been at work at the Jetties at the mouth of Mississippi river, who left by rail for their homes when the yellow fever broke out there. Nelson died at his home in St. Louis on August 15th, having been sick five days. A day or so after his death Austin went to his uncle's house and sat on the door step while the coffin was taken past him, but did not go into the house, and did not accompany the funeral. Four days after Nelson's death, viz., on the 19th of August, Austin again went to his uncle's house, and on this occasion went in and sat in the front parlor several hours. He was known positively to have been in the back parlor also, in which Nelson died, which is separated, as usual, by folding doors from the room in front. Seventeen days after this visit, on the 5th of September, not having had any attack of chills and fever, and being meanwhile apparently quite well, he was taken sick, his mother informed Dr. Ford, with chilly sensations, languor, dizziness, vomiting and pain in the back of the head. There was high fever, which never left him, though his symptoms, especially the heat of skin, were aggravated towards afternoon and in the early part of the night. During the first three days of his sickness, he vomited once or twice, and had much delirium at night; he had no further chills or rigors. Dr. E. H. Gregory was sent for, who requested Dr. Ford to conduct the case. When first seen by Dr. F., at 4.30 P.M on the 8th of September, there was much injection and some distinct yellowness of the conjunctivæ. The face was flushed, and there was distinct but not grave congestion of the skin generally. Bowels had been constipated, but had been moved by oil and Wright's pills. Much thirst, but no nausea. Temperature, $101\frac{3}{4}°$; pulse, 120; pale and weak. No headache or other pains. No albuminuria. No tenderness at the epigastrium. The skin has been uniformly dry, except for a few minutes this afternoon. His general tint is dusky, and there was much improvement of the capillary circulation, especially in the extremities. The

tongue is thickly coated with a yellowish creamy fur. He was ordered, calomel grs. ij every fourth hour, veratrum gtt. ij, and fluid ext. jaborandi gtt. iv, every two hours, and as much fluid in small quantities at a time, and cracked ice, as he desired. This treatment was continued for a couple of days, and the calomel was then omitted, and ol. ricini administered. The veratrum and jaborandi were continued for several days, and followed up by quinine in doses of twenty-five or thirty grains a day.

The diagnosis was yellow fever in a mild form with some likeness to dengue.

On Sept. 9th at 10. A. M. he vomited; at 6:30 bled from the nose a little; the temperature, which had risen the night before nearly to 103°, under the conjoint influences of the veratrum, and of the refrigerant effects of the sweating induced by the jaborandi, had by this time declined to 100 ½°; pulse, 64. He continued to prespire moderately all that day, and was not allowed to cover himself with more than a sheet and light coverlet. Found the sheet alone enough, as the weather was very hot and sultry. At 5. P.M.—Temperature, 98 ¾°; pulse, 72; tongue moist, urine free. No headache, but only a feeling of fullness in the back of the head; no pain any where. Has had no nausea or vomiting; thirst abated; bowels have been moved once in a very large bilous stool. The absolute diet was continued, a little weak tea without milk being allowed. At 10. P.M. the temperature was 99°: pulse, 66; had taken three doses of veratrum and jaborandi since the last visit, viz., at 4, 6 and 9. P. M. No headache or other pains. Tongue very soft, and mouth slightly watery, indicating the sialagogue effects of the jaborandi. He had been gently perspiring. Asleep when the visit was made. He was ordered to be lightly covered with a sheet, and draughts to be kept from him. The weather was much cooler since dusk, in consequence of heavy rain and wind from the north.

On Sept. 10th, he continued in a favorable condition. Urine was freely passed; there was no albumen in it. There was no nausea or tenderness at the epigastrinm. The tongue was less coated, and moist. The eyes were quite yellow. The sluggishness of the capillary circulation, on the surface of the body generally, was not as marked as it had been, but was still quite evident. Temperature, 98 ¼°; Pulse, 56. The calomel was stopped, and a dose of castor oil ordered. The veratrum and jaborandi were continued, and ordered, for 11. A. M, 2. P. M. and

6. P. M. Lemonade was allowed him, but nothing else whatever, except cracked ice.

After this he continued to improve gradually, and got quite well. He was visited alltogether seven days, and was sick ten days, not including the period of his convalescence, which was prompt and uninterrupted. His case, upon diligent inquiry, was found to have been the only one of febrile character which had occurred in the whole season, in the house in which he lived, or in the houses next on the north, east, south, or west, across the street. It is not possible to doubt but that his attack was either precipitated or directly caused by his visit to the room in which his uncle died of yellow fever, his system being at the time deranged by the influences of the heat and fœtid emanations of the back-yard, whose unhealthy air he inhaled every night.

DR. B. ROEMER, 1204 Chouteau avenue, states that on September 12th, two days after the death of the child already referred to by him in a former communication, a nurse girl in the family was taken sick, removed to her home on DeKalb street, and, on being visited by Dr. R. the same day, was sent by him to Quarantine, where she died of yellow fever. This patient was a resident of St. Louis, a German girl, who had never been to the South, and had been engaged to nurse the sick child above named.

Sophia Elberts, living on Duncan Island, at the foot of Carrol street, about 58 years of years, was visited first by Dr. R. on September 13, 1878. He found her *in vinculo mortis*, the whole floor and bedclothes streaked with black vomit, and the cadaver of a more than orange—nearly of an olive—color. A steamboatman from Natchez, Miss., who had been taken at Cairo with yellow fever, had been lodged at Elbert's house; but, after being sick some days, had been removed to Quarantine, where he died. The woman and the man from whom she contracted the fever, according to the data at hand, died on the same day. This woman had never been South.

Dr. Roemer states that, in his opinion, during the prevalence of febris icterodes, we always have a concomitant disease which might be called *icteroid*, as in epidemics of cholera asiatica, we have *cholerine*. The malarial diseases prevailing during yellow

fever show an unmistakable disposition to partake of the characteristics of yellow fever.

During last summer and fall, malarial fevers were much more prevalent than usual. Dr. R. believes in the contagiousness of yellow fever, and, therefore, that only an unconditional quarantine will save a city from its contact, and that mere sanitary regulations are not sufficient.

DR. C. N. H. HANSMANN, 1003 North Tenth street, reports the following case:

——— Kirsch, a native of Lorraine, æt. 35, had been living several years in America, of late in Detroit. He arrived in St. Louis from Detroit, directly, about August 14, 1878, and took a situation as workman in railroad workshops in East St. Louis, living in St. Louis at 1121 North Tenth street, and going across the river every day to his work. Two boat hands just convalescing from yellow fever, who had come to this city on a steamer from the South, were in the same house with Kirsch, and lived in the next room, which did not communicate directly with Kirsch's room, but like it, opened upon an elevated back yard. These men were boarding in this house when Kirsch took lodgings in it, and the Doctor supposes they became acquainted with Kirsch and were not infrequently in his room, or he in theirs, as on one occasion he found these two men in Kirsch's room, sitting upon his bed. After Kirsch had been in the city six days, he was taken sick, and two days afterwards, viz., on the 22d of August, he was first seen by Dr. Hansmann. He had had heavy chills followed by high fever of a continuous type; great oppression at the praecordia; tenderness in the epigastric region, and nausea; intense pains in the back, but no headache; the face was flushed and conjunctiva injected and profound general prostration; the bowels were constipated. The next day the fever was declared, and he had no subsequent chill. He now vomited occasionally, but glairy matters only, except for a short time a little grumous matter like black vomit. At this time there was some yellowness of skin, but the conjunctivæ were very distinctly colored, much more so than is usually seen in remittent fever. Dr. Hansmann attended him for a week; he recovered.

Dr. Hansmann also relates the following case, which seems to have been one of the remittent type of yellow fever; whether or not it was induced by the patient's visit to the steamer, must be left to the judgment of the reader. This case and the one afterwards mentioned seemed to be of the same character, provoked, apparently by a visit to infected places:

Mr. W. H. P——, a salt dealer living at the corner of Tenth and Carr streets, æt. 35; a resident of St. Louis for a long time. He led a very regular life and had never been to the South. The steamer Stanard came up to St. Louis about the 15th of October, having been detained at Quarantine three weeks. She had had many cases of yellow fever on board and was regarded as very badly infected by the health officers. Mr. P—— had a consignment of salt from New Orleans piled on the main deck of the vessel. Many of the crew, sick of yellow fever, had lain on this salt and soiled it in various ways. On the 16th of October Mr. P. went on board the Stanard lying at the foot of Plum street to attend to the landing of his salt. He had it examined, and sent up all the clean sacks to his warehouse at the corner of Tenth and Carr streets, remaining on the main deck, while this was done, for about a half an hour, as he states himself, to a member of the committee. This was the only visit he made to the steamer. He had had intermittent fever in previous years, but not that summer, and had been a little bilious three weeks before this occurrence, and says he was not quite well when he went on board the steamer. Three days afterwards, viz., at 1 o'clock A. M. on the morning of October 20th he was taken suddenly with a terrible chill. He was seen the same day at 8 or 9 o'clock, by Dr. Hansmann. The face was not much flushed, nor was the fever very high, but there was marked injection of the conjunctiva, and oppression at the epigastrium; the bowels were constipated; there was a disposition towards nausea, and the tongue was dry but not distinctly coated; on the evening of the 20th he had another chill, and on the next morning said he felt a good deal better, but had chilly sensations on the evening of the 21st and much pain in the back; he was still better on the 22d, when his bowels acted with profuse bilious evacuations; there was no observable yellowness of the eye, and little, if any, of the skin. After this he continued to improve and got well, after about a week's sickness. About two weeks after this he rode out with his family in a carriage, and had a recurrence of his attack, though in a milder form.

The salt which was removed from the steamer Stanard was carried to the premises where Mr. P. lived, and his chamber was in the same building near by, on the second story.

The following note was left for Dr. Hansmann by Drs. A. C. Robinson and E. W. Jameson of the Health Office:

DR. C. HANSMANN:

DEAR SIR:—We called to see Mr. P———, and found him with every symptom of yellow fever, together with a history pointing to that diagnosis. In addition to this, the steamer Stanard is a perfect pest-house, several hands having died on board of her; and the fact is that he (M. P.) was sleeping directly over his consignment of salt which was taken from that boat. We advised his removal to Quarantine. We told him that his neighbors reported the case and will call and see you this afternoon.

Very respectfully,

A. C. ROBINSON M. D.,
EDWARD. W. JAMESON M. D.

Dr. Hansman states that a prominent city official made a visit to Quarantine in company with several gentlemen, a few days before the disestablishment of that institution for the season, viz., about the 16th of November. The gentleman in question, is disposed towards biliousness and intermittent fever, but had had no such attack last year up to the time of his visit to Quarantine. On the 20th of November, viz.: four days after the visit, as in the case of Mr. P., he was seized with a very heavy chill early in the morning, and at noon on the same day, had a second chill. The ensuing fever did not run very high, leaving him that night. He had a recurrence of the chills the next day, and was sick altogether three or four days.

CASES OF YELLOW FEVER ARISING BY CONTAGION FROM CASES TRANSPORTED BY THE STEAMER EDWARDSVILLE.

The steamer Edwardsville was an old ferry-boat, of some forty-five feet beam and one hundred in length, belonging to the Wiggins Ferry Company, and formerly used between St. Louis and East St. Louis. Having been put in repair, she was hired by the Health Department, and about August 23d, 1878, was placed in position, in connection with the ambulance service, at the foot of Miller street, for the the transportation of supplies and pa-

tients sick with yellow fever, or reasonably supposed to be so, to the Quarantine station, some fifteen miles below St. Louis, on the right bank of the Mississippi. For these purposes the boat was kept nearly fired up, night and day, subject to the Health Commissioner's orders, for the immediate deportation of patients reported at the Health Office by physicians attached to the Health Department. Trips were made every day, sometimes twice a day, and on nearly every trip some patients were taken down, and on several occasions three or four at a time. A physician was constantly on the boat, eating and sleeping there, whose duty it was to supervise the reception and debarkation of the patients, and to attend to their wants in the way of treatment while on the river. Dr. Hanna occupied the position of physician on board the steamer up to Sept. 1st, 1878, and was succeed by Dr. W. H. Renick, who remained in charge until the 20th October, when the boat was put out of commission. Several nurses were engaged in attending upon the sick, in transit, up to Sept. 1st; from that time but one man was in attendance as nurse, viz., Rudolph Kettlekamp.

During the season two persons successively occupied the position of captain and pilot, viz., Wilson, up to Aug. 23d, and from that date, Wm. Conley, to the time of his death by yellow fever on Oct. 20th. The engineers, crew and captain slept on board of the boat. The service of the boat during the time it was in commission was as follows: 2 pilots or captains; 2 engineers; 1 cook; 4 deckhands; 1 nurse.

No one held any communication with the hold of the steamer; all materials and supplies being transported on the main deck, as well as the coal used for the boilers, nor was the hold entered at all during the season until after the occurrence of yellow fever among the employes of the boat, when the entire vessel was disinfected. The boilers and engines were on the main deck, and the wheel in the middle of the boat; the kitchen was on the main deck, in the rear of the wheel, having been constructed as a temporary addition for the purpose. On the main deck at the stern of the boat, about thirty feet from the kitchen, a wall-tent was pitched for the use of the crew not on duty. A stairway led to the hurricane deck, on which was situated the cabin, an apartment about twenty feet long by as much wide, which had been the sitting-room for passengers when the boat was used as a ferryboat; behind this, towards the stern, were

water closets, and two small state-rooms, one of which was used as a sleeping-room for the physician in charge and the other for the nurse. The sitting-room was fitted up as a ward with accomodations and beds for six patients. When received at the wharf in St. Louis, the patients were regularly put to bed, and taken down to Quarantine immediately.

But few patients were on the boat more than an hour and a half. Many of these patients were very very ill, some of them suffering with the most pronounced symptoms of yellow fever, such as suppression of urine, delirium, convulsions, black vomit and hemorrhages, often dying within twenty-four hours after arriving at Quarantine. The patients thus transported were persons who had arrived sick in St. Louis from Southern cities, or had been attacked with yellow fever after a longer or shorter sojourn in the city as refugees from the South.

There was no case of anything like yellow fever among any of the employes of this boat during the whole season, notwithstanding the daily transportation of the sick and communication with Quarantine, until the 9th of October, when within a few days several of the crew sickened and died. These cases are here subjoined.

CASE I.—Nicholas Gafft, a German, æt. 45; was cook on the steamer for the crew. He had never been in the hold of the vessel, nor in the ward on the hurricane deck, which he had been cautioned not to enter, according to his statement to Dr. W. H. Renick. Dr. J. H. Moore, subsequently physician in charge of Quarantine, who saw him at his residence, at the corner of Tenth and Gratiot street, affirms that Gafft admitted to him that he had entered the ward once. He usually slept at home, viz., whenever the boat did not go down at night, returning to his post very early in the morning, and never leaving until after he had cooked and served the supper for the crew, going home usually about 9 P. M. nearly every night. The house he lived in, was situated in a well drained part of the city, but was found by the Inspector, Dr. J. H. Moore, by no means in good condition. No cases of fever had occurred around the residence, nor were there any during the rest of the season, except in the case of Gafft's wife, as will be detailed; these facts are certified to by Dr. Renick and Dr. Moore, who visited the premises and disinfected them as soon as the nature of Gafft's illness became known to

the health authorities, and before Gafft's wife was taken sick. Gafft had been many years in the employment of the Wiggins Ferry Company. It is known *positively* that he had not been to the South in the year 1878.

On the 9th of October, Gafft complained to Dr. Renick that he felt as if he was about to have a chill, and asked for some quinine; this was on board the boat. He slept at his residence that night, and came back to the boat early next morning, but felt too sick to cook, and without leave returned to his residence. One of the deck hands reported at the Health Office that he had been seen to vomit, and that he was very sick, whereupon Dr. J. H. Moore, one of the inspecting physicians, visited him promptly at his residence. The doctor at once recognized his case to be one of yellow fever, and had him immediately returned to the steamer and transported to Quarantine. Dr. Renick, in charge of the boat, concurred in the diagnosis of Dr. Moore; and Gafft died at Quarantine thirty hours afterwards, his case having presented all the characteristic symptoms of yellow fever, including black vomit. He was sick just three days.

CASE II.—Rudolph Kettlekamp was employed as nurse, day and night, in the ward of the steamer Edwardsville; he lived on board, eating and sleeping on the boat. He slept in one of the small state-rooms already described, in the rear of the sitting-room or ward. He was engaged as nurse about the 20th of August, and was expected to be on duty as long as patients were in transit. On the 15th of October he was observed by Dr. Renick to be indisposed; his eyes suffused and injected. He knew he was sick, but was very fearful of being sent down to Quarantine, and hence probably suppressed his symptoms as long as he could. His tongue was coated with a light creamy fur; appetite was lost, and he complained of being somewhat chilly. He was observed by Dr. Renick to be very restless; lying down, then getting up and walking about, and lying down again. On the night of the 15th, he remained on the boat as usual, and it was suggested to send him to Quarantine for treatment in one of the intermittent fever wards, as at this time it was not suspected that his case was one of yellow fever. By the night of the 16th of October the mental prostration had greatly increased; he was constantly nauseated, and vomited frequently, and had frequent passages from the bowels, with much straining. His case was still re-

garded as one of malarial fever of severe type, and he was accordingly sent to Quarantine the next day for treatment, where he died, after an illness lasting eight days more, having had black vomit, hemorrhages and other characteristic symptoms of yellow fever. Kettlekamp had never been to the South, nor indeed out of St. Louis, for thirty or forty years. When he arrived at Quarantine he was placed in the malarial ward,—as his case was still thought by Dr. Renick to be of malarial character,—between two men, named Geo. Thurliss and Fred. Niemeyer; one affected with chronic bronchitis and the other with intermittent fever. This was done on October 17th, late in the evening. After twenty-four hours, however, Kettlekamp's symptoms were seen to be those of yellow fever, and he was promptly removed to the yellow fever ward, where he died some days afterwards. The patients on either side both contracted yellow fever from him, and will be alluded to in the detail of cases of contagion at Quarantine. One of them recovered; the other died with the usual symptoms of yellow fever.

CASE III.—George Fox, æt 24 years, a stout young man of Swedish descent, one of the deck hands, was taken sick in the tent alluded to on the main deck of the Edwardsville, used as a sleeping room for the hands not on watch, on the same day that Kettlekamp's indisposition was first observed, viz., 15th of October. The tongue was thickly coated; there was suffusion of the eyes, and injection of the conjunctivæ; pains in the back of the neck, and much stupor. He had had a chill; there was much flushing of the face, and high fever, but no noticeable tenderness at the epigastrium. The case was regarded by Dr. Renick as one of yellow fever, and Fox was taken down to Quarantine that same day, where he died, after an illness of forty-eight hours, having had black vomit and hemorrhage from the bowels. Fox had never been to the South.

CASE IV.—Ann Gafft, Irish, wife of Nicholas Gafft, cook on the Edwardsville, was taken sick three days after her husband was removed from his residence on Tenth and Gratiot streets, and sent down to Quarantine. She had been in the habit of coming down to the steamer to see her husband, and on these occasions is supposed to have gone on board the boat. Indeed, Dr. Renick affirms this is pretty certainly known to have been the case. She was reported sick to the Health Office by her neigh-

bors, after she had been already sick a day or so, on the evening of October 13th, twenty-four hours after the death of her husband at Quarantine. One of the Inspecting Officers, Dr. J. H. Moore, visited the premises at 6 P. M., and found Mrs. Gafft in the back room, lying on an old lounge, thickly covered, notwithstanding the heat of the weather, with several quilts. On removing these, the characteristic odor of yellow fever became perceptible. Her face was flushed; eyes congested; tongue red and tremulous, and sordes encrusted the teeth. The temperature was very high; prostration intense, so much so that she could not lift herself up. The premises had been disinfected by Dr. Moore, when he visited Nicholas Gafft a few days before this. The Doctor reports that he found the front room tolerably neat, but the back room was badly kept, and the cellar very damp and dirty, several tubs containing foul water standing around, one of them still having the clothes in it which Gafft had on when he came home from the steamer to go to bed. The back-yard was also in bad condition, with a privy vault in the rear without water connection, which Dr. Moore thoroughly disinfected, finding it to be very offensive. Dr. Moore pronounced Mrs. Gafft's case to be one of yellow fever, and had her sent down to the steamer for transportation to Quarantine. Dr. Renick saw her on the steamer, and fully coincided in Dr. Moore's diagnosis. She was taken down to the river the same afternoon, arriving at Quarantine at 4 P. M. on the 13th of October, and died the next day, after having all the worst symptoms of yellow fever, including black vomit. Dr. Renick thinks it more than probable that she slept on board the steamer occasionally, when visiting her husband.

CASE V.—DR. L. M. MCCABE, 604 Chestnut street, St. Louis, communicates the following in relation to the Captain of the Edwardsville:

Wm. Conley, æt. 66, born in Pennsylvania, living in St. Louis and on the river thirty-five or forty years. Had had attacks of malarial fever in 1876, and in 1877 especially, in September and October. Conley had been acting as Captain and pilot of the Edwardsville some weeks before Dr. McCabe saw him. When the boat was in town he slept at home, but all day and a good part of every night he was on board the steamer. He was

habitually careful not to approach ambulances, and was scarcely ever in the sick ward or cabin of the steamer. Conley had been up in the head waters of the Missouri River in the spring and early summer of 1878, and after returning to St. Louis,—never having been South or down the river,—took the position of Captain of the Edwardsville.

Dr. McCabe saw him first on Tuesday, October 15th. He had had a slight chill, and left the boat on the 11th or 12th of October, going home to his residence, at 1006 Glasgow avenue. He felt much indisposed, and feared he was going to be sick. When first seen he had moderate fever; there was no vomiting; the tongue was slightly furred, and the fever was irregularly remittent. Conley was a man of spare build, but of vigorous constitution. The fever intermitted entirely for forty-eight hours, and then reappeared in a continuous form. There was now slight delirium; moderate temperature; occasional sweats; but little nausea, and vomiting only once, of some milk. He never vomited bilious matters or anything like black vomit. The bowels were at first constipated, diarrhœa afterwards supervening. Towards the last partial suppression of urine manifested itself, becoming complete for the last eight hours of life. The patient never had any other chill than the one already recorded. During life the conjunctivæ became somewhat yellow, and injected to some extent. He died comatose on the night of Sunday, October 20th, at 8 P. M. After death he became very yellow indeed. There was no autopsy. The diagnosis was "yellow fever."

CASES OF YELLOW FEVER DEVELOPED AT QUARANTINE.

CASE I.—Barney McSorley, æt. 55, was steward at Quarantine Hospital, and had been a resident at Quarantine for about a month, viz., from August 1st, when he was taken sick. The first case of yellow fever was admitted on Aug. 21st, and from that date until Sept. 2nd, 29 cases of indisputable yellow fever, of which seven died, were admitted. McSorley was occasionally in the wards. He slept in the building designated on the plat of the Quarantine grounds annexed, as the "new brick house," 50 feet distant from the nearest ward, which, however, was used solely for malarial cases, at least at first, and about 180 feet from the ward on the north used for yellow fever cases. He was taken sick on the 1st or 2nd of September. The fever was continuous;

there was albuminuria and partial suppression of urine; there was much peristent vomiting of glairy matters, but not clearly of black vomit. A special feature in this case was the inordinate irritability of the stomach; there were no hemorrhages, but great prostration. McSorley lingered for about three weeks, and ultimately recovered, although after a relapse, sometime afterwards.

CASE II.—Dr. H. C. Davis, æt. 26, physician in charge at Quarantine. Dr. Davis had been attending to the inspection and fumigation of the steamers and barges arriving at all hours from the South, for these purposes visiting every part of the vessel. He also attended the sick in the wards, and lost a great deal of sleep. He was taken sick with a chill on Oct. 8th, followed by continuous fever and great prostration; the urine was albuminous, and became eventually suppressed. He vomited black vomit, and died delirious on the 15th of October. Dr. Davis had not left his post during the season, not even to come up to the city. Just before Dr. Davis was taken sick, viz., about the first week in October, he was frequently about a privy, distant some 30 feet west of the kitchen, which had become so offensive that it was necessary to clean it, and remodel its masonry so as to allow a stream of water to pass through it. Dr. Davis superintended this operation, and, according to statements of Dr. J. H. Moore, afterward physician in charge, was known to have descended into the vault more than once. All engaged in the work represent the stench to have been fearful. Within a few days after this he was taken sick with yellow fever.

CASE III—Kate McSorley, daughter of the steward, æt. 15, slept in the building marked as the "new brick house," on the second story, in a room opening on the north, 30 or 40 feet distant from the privy already spoken of. Since October the 1st this privy had been noticed as very offensive, being an old and deep vault without an outlet. A few days afterwards, as has been said, the privy was remodelled, and besides this, certain changes were made in the drainage from the kitchen which had become ineffective. Some few days after this Kate McSorley was taken sick, about the 10th or 12th of October. She had been nursing Dr. Davis very assiduously. Her case presented all the characteristic symptoms of yellow fever, and she died on the fourth day, viz., on Oct. 15th, some time in the evening or night.

CASE IV.—Dr. J. H. MOORE, physician in charge after the death of Dr. Davis, communicates the following:

Richard McDonough, an Irishman, æt. 32, living in America many years; he was an engineer by trade, and employed in that capacity at Quarantine. He had visited the city after the opening of Quarantine. About the 1st of October he was employed in cleaning and remodelling the privy vault already alluded to. This vault was a very filthy place, in use for many years, and devoid of drainage. It was about 15 feet long 3 or 4 feet wide and 10 feet deep. It was situated just 35 feet west of the new brick house, and is marked on the plan of the Quarantine grounds annexed. It was determined to pass a stream through the vault, and McDonough attended to and executed most of the work, descending into the vault for this purpose. This was about the 1st of October. About the 7th of October, he was taken sick, with what Dr. Moore declares to have been unmistakable yellow fever. The fever was continuous, with great irritability of the stomach, though no black vomit was ejected. There was albuminuria, but no hemorrhages; the prostration was great; there was slight icteroid coloration of the conjunctiva. He was ill about seven weeks, convalescing very slowly.

CASES V and VI.—Dr. J. H. Moore also states the following as his personal observation, being at the time physician in charge of Quarantine:

Rudolph Kettlekamp, nurse on board the Steamer Edwardsville, was brought down late in the evening of Oct. 17th, to Quarantine. His symptoms had been dubious (see history of his case in the detail of cases on board the steamer), and had not been distinctly recognized as those of yellow fever. He was accordingly placed in one of the wards devoted to the treatment of remittents and intermittents, between two men, who lay on cots separated from each other by an interval of about four feet. One of these men was George Thurliss, born in England, aet. 23, a peddler, from Chattanooga Tenn. He had been admitted with intermittent fever on August 19th, and was getting well. The man on the other side of the cot on which Kettlekamp was placed, was named Frederick Niemeyer; he had been admitted some time before, on Sept. 4th, for chronic bronchitis. The cot lay north and south; Thurliss was on Kettlekamp's right; Niemeyer on his left, directly next him. There were a number of other patients in the ward.

After Kettlekamp had lain in the malarial ward between these two men for twenty-four hours, his symptoms were recognized by Dr. Moore as unmistakably those of yellow fever, and he was at once carried into a ward devoted especially to yellow fever, where he died some days afterwards with characteristic symptoms of yellow fever.

Thurliss and Niemeyer had been thought to be convalescent, and the diagnosis of intermittent and of chronic bronchitis was well established. On October 25th, just one week after Kettlekamp had been placed by his side, Fred. Niemeyer developed symptoms of yellow fever, passing through a definite attack of the disease, from which, however, he recovered eventually, being sent to the City Hospital on November 20th, upon the disestablishment of Quarantine for the season, while as yet not quite well. Niemeyer had had only a chronic bronchitis, as already stated.

On October 20th, three days after Kettlekamp had been deposited next him, George Thurliss, who had been sick since August 19th with intermittent fever, and was getting well, was attacked with yellow fever of a very pronounced character, and died in two days. All of this happened under the eye of Dr. Moore, who himself attended the three men.

Kettlekamp had lain between the men just twenty four hours, having yellow fever himself in a highly pronounced form. The patient who had not had a febrile disease, viz., the one suffering from bronchitis, sickened of yellow fever in a week, while the other man, Thurliss, who had already a fever, viz., intermittent, was attacked in three days, and died very soon. Niemeyer and Thurliss, viz., the two men directly in contact with Kettlekamp, were the only men attacked at the time, or subsequently, with yellow fever in that ward.

These are all the cases of indisputable yellow fever originating at Quarantine during the season, in persons of who had not been exposed to the disease in some of the Southern cities. The Health Commissioner, however, affirms that there was a marked disposition on the part of employes sent down to Quarantine from the city to sicken, after being on duty for a few days or more, with febrile disorders apparently allied to yellow fever. This sickening of the attendants and nurses was, throughout the season, the source of much inconvenience and trouble to the Health Department.

A TABLE SHOWING THE PRINCIPAL FACTS OF THE FOREGOING EIGHTEEN CASES OF YELLOW FEVER DEVELOPED BY CONTAGION IN RESIDENTS OF ST. LOUIS WHO HAD NOT BEEN TO THE SOUTH IN THE YEAR 1878.

No.	Name.	Age.	Sex.	Color.	Nativity.	Residence in St. Louis.	Source of Contagion.	Date of Contagion.	Date of Attack.	Date of 1st visit	Attending Physician.	Where Treated.	Duration of illness	Termination.
1	—— Kirsch........	35	Male.	White.	Lorraine.	1121 N. Tenth.	Co-lodgers from the South.	Not before Aug. 14th.	Aug. 22	Aug. 22	C. N. H. Hansmann.	At his residence.	9 days	Recovered.
2	J. Becker..........	53	Male.	White.	Germany.	City Hospital.	The person of Isaac Baer.	Not before Aug. 20th.	Aug. 26	Aug. 26	D. V. Dean.	City Hospital.	5 days	Died Aug. 31.
3	Mollie Dillon.	19	Fem.	White.	United States.	718 Christy Ave.	Persons from the South.	Unknown.	Aug. 29	Sept. 2	T. O'Reilly.	Female Hospital.	....	Recovered.
4	Barney M'Sorley...	55	Male.	White.	Unknown.	Quarantine Hospital.	Patients from the South.	Not before Aug. 21st.	Sept. 1	Sept. 1	H. C. Davis & P. G. Robinson.	Quarantine Station.	21 days	Recovered.
5	Austin Walsh.......	17	Male.	White.	St. Louis.	1408 N. 14th Street.	Apartments where E. Nelson was sick.	August 19th.	Sept. 5	Sept. 8	W. H. Ford.	1408 N. 14th Street.	10 days	Recovered.
6	Sophia Elberts......	58	Fem.	White.	Unknown.	Foot of Carroll Street.	Yellow fever patient from Cairo.	Not before Sept. 5th.	Sept. 10	Sept. 13	B. Roemer.	Foot of Carroll Street.	3-4 days	Died Sept. 13.
7	Nurse Girl...........	..	Fem.	White.	Germany.	DeKalb Street.	The person of Mr. W——'s child.	Not before Sept. 7th.	Sept. 12	Sept. 12	Dr. B. Roemer & Quar. Staff.	Quarantine Hospital.	....	Died Sept. 17.
8	Rich. M'Donough...	32	Male.	White.	Ireland.	Quarantine Hospital.	Patients from the South.	Unknown.	Oct. 7	Oct. 7	Quarantine Staff.	Quarantine Station.	7 weeks	Recovered.
9	H. C. Davis.........	26	Male.	White.	United States.	Quarantine Hospital.	Steamers or patients from the South.	Unknown.	Oct. 8	Oct. 9	P. G. Robinson.	Quarantine Station.	7 days	Died Oct. 15.
10	Nicholas Gafft.......	45	Male.	White.	Germany.	Quarantine Steamer.	Patients in transit.	Unknown.	Oct. 9	Oct. 9	W. H. Renick.	Quarantine Hospital.	3 days	Died Oct. 12.
11	Katie McSorley.....	15	Fem.	White.	United States.	Quarantine Hospital.	Patients from the South.	Unknown.	Oct. 11	Oct. 12	P. G. Robinson.	Quarantine Station.	4 days	Died Oct. 15.
12	Ann Gafft...........	42	Fem.	White.	Ireland.	10th and Gratiot Streets.	Steamer Edwardsville.	Unknown.	Oct. 11	Oct. 13	W. H. Renick.	Quarantine Hospital.	3 days	Died Oct. 14.
13	Rudlph Kettlekamp.	45	Male.	White.	Germany.	Quarantine Steamer.	Patients in transit.	Unknown.	Oct. 15	Oct. 15	W. H. Renick.	Quarantine Hospital.	5 days	Died Oct. 24.
14	George Fox..........	24	Male.	White.	Sweden.	Quarantine Steamer.	Patients in transit.	Unknown.	Oct. 15	Oct. 15	W. H. Renick.	Quarantine Hospital.	2 days	Died Oct. 17.
15	Wm. Conley........	66	Male.	White.	Pennsylvania.	Quarantine Steamer.	Patients in transit.	Unknown.	Oct. 12	Oct. 15	L. M. McCabe.	1006 Glasgow Ave.	8 days	Died Oct. 20.
16	W. H. P——.......	35	Male.	White.	America.	Cor. 10th and Carr Sts.	Steamer Stanard.	Oct. 16th.	Oct. 20	Oct. 20	C. N. H. Hansmann.	At his residence.	7 days	Recovered.
17	Geo. Thurliss.......	23	Male.	White.	England.	Quarantine Hospital.	The person of R. Kettlekamp.	Oct. 17th.	Oct. 20	Oct. 20	J. H. Moore.	Quarantine Hospital.	2 days	Died Oct. 22.
18	Fred. Niemeyer....	..	Male.	White.	Germany.	Quarantine Hospital.	The person of R. Kettlekamp.	Oct. 17th.	Oct. 24	Oct. 24	J. H. Moore.	Quarantine Hospital.	4-5 weeks	Recovered.

Of these 18 patients, 7 recovered and 11 died, a mortality of 61 per cent.

The mean duration of the incubative period, in the cases where this was determinable, was 7.1 days.

The occurrence of these cases, in subjects who had not been out of St. Louis during the summer, and who, with the exception of Kirsch, Mollie Dillon, Thurliss and Niemeyer, were permanent residents or even natives of this city, conclusively establishes the contagiousness of yellow fever.

It will be observed that cases by contagion were affected as early as the middle of August, but that from the end of September to the middle of October the greatest number of cases occurred. This would seem to show that towards the end of the season the receptivity becomes greater and contagion is more readily accepted, which thus conforms to what is observed in the South in acclimated cities, when yellow fever prevails. Here the old residents are not attacked until the close of the season, if at all. The constitutions of such acclimated individuals, by the fact of what we call acclimation, seems to refuse to be thrown into the condition of receptivity referred to by the influences producing the epidemic, and yields only to the continued pressure of the long season. The lack of receptivity, thus due to acclimation, prevents the acquisition of the disease at the South, until October or November; while in the latitude of St. Louis, it must be held that the lower grade of the meteorological influences is unable to induce a receptivity adequate to accept yellow fever until late; at least this view seems to be supported by the relations of yellow fever to St. Louis, Cairo and Louisville, and will be again referred to. From the table we perceive that in August only three cases of yellow fever, due to contagion, occurred, notwithstanding the fact that in this month a greater number of refugees were pouring into St. Louis than at any time subsequently, and also that two-thirds of the cases developed here in the persons of refugees occurred in the month of August, and that during the last *week* of the same month, half as many admissions for yellow fever at Quarantine are noted as for the whole *month* of September, while the admissions by yellow fever at Quarantine for the month of October were only nineteen, half of which number consisted of patients included in the foregoing table. Contagion, therefore, was accepted by these local cases only late in the season.

SECTION IV.

CASES, EITHER OF YELLOW FEVER OR CLOSELY SIMULATING THAT DISEASE, ARISING IN ST. LOUIS AND ITS SUBURBS, WITHOUT KNOWN CONTACT WITH OTHER CASES, OR WHERE NO SUCH CONTACT EXISTED.

DR. CARL SPINZIG, 1300 South Fifth street, saw a young man æt. 21 or 22 years, on the 21st of August, 1878, on Jackson street, between Miller and Berry streets. This young man had been born in St. Louis, and had never been away from the city, as far as could be learned, and positively not during the year 1878. He had not been in contact with any steamer coming from the South, nor with any patient sick of yellow fever, nor with any person coming from the South. These facts were carefully inquired into at the time of the Doctor's first visit, and much pains was taken to verify them, and the statements above made were such as to show their correctness, especially in the absence of any incentives to a false statement.

Dr. Spinzig's first visit was made on the second or third day of the attack, judging from the symptoms. The attack was ushered in with fever, but an antecedent chill was not mentioned. The stomach was very irritable, and the epigastrium very tender to pressure. He was vomiting black vomit occasionally, of which the doctor saw about half a pint in a basin. The tongue was dry, crusted and dark; intelligence disturbed, and facies altered. The skin was markedly yellow,—even more so than in a patient from New Orleans whom the Doctor saw in 1873. The eyes were much colored; the bowels were constipated.

Dr. Spinzig saw the youth again the next day. He was somewhat better. On the 23d the improvement was still more pronounced, and convalescence was soon established. The Doctor saw him but twice, but heard from him after his second visit.

This young man worked in a varnish factory, and slept on the ground floor of the house where he lived, where malarial fevers were very prevalent, the locality being noted as unhealthy all the year round. A great part of the area around the house is well known to have been filled, having been originally of low level.

DR. E. A. VOGT, corner Jefferson and Benton avenues, reports a suspicious case in the person of a peddler of small fruits, named Rice, æt. 43. The patient was of German birth, but had been living in St. Louis for the past ten or fifteen years. His residence when sick was on Lindell avenue, near Lindell Park. All history of contact of the patient with persons sick of yellow fever, or of his presence in infected places, was denied by his wife. He was a vender of small fruits, and was not an orange or banana dealer, and was not known to have had any communication whatever with vessels, or freight of this kind coming from the South. The patient's residence was a frame house, and the premises were quite clean. There are some drains in the neighborhood, and Dr. Vogt had seen cases of typho-malarial fever of very bad type last season in this neighborhood. These he attributes to the emanations from the open, unfinished, mouth of the Rocky Branch sewer and a draining ditch between Grand avenue and Lindell avenue, about 300 steps from the house of the patient, Rice. Dr. Vogt has frequently perceived a bad smell arising from the Rocky Branch sewer mouth, distant from Rice's dwelling about 1,000 steps.

Rice was habitually a hard drinker; he was a short, strong, apparently quite healthy man, though of somewhat flabby fiber; he had never been seriously sick before, for at least a long period. Dr. Vogt first saw him on September 13th, 1878, at 7 A. M. His temperature was then 105°. He had been indisposed for some forty-eight hours before, and had had a chill on the 12th. Pulse full and very compressible, 100. He had been vomiting the evening before and through the night, but his wife took no notice of this, particularly, as she imagined him to have been drinking more than usual. Towards morning he became speechless. When Dr. Vogt saw him, his intelligence was perfect, but the prostration was extreme. The sphincters were relaxed, and during the visit he vomited dark lumps of coagulated blood, mixed with bile. His wife stated that he had vomited the same kind of matter during the night. The facies expressed great anxiety, and there was fearful moaning and jactitation. The conjunctivæ were very yellow, and somewhat injected. The skin in general, and the breast especially, were very yellow; indeed, more than is commonly seen in ordinary jaundice. Black matter, soiling the bedclothes, was passed by the bowels, of an intolerable odor. He died on the same day that Dr. Vogt saw him,

at 10 or 11 o'clock P. M. Dr. Vogt caused all the bedding to be burned. Rice's wife was sick for five or six days after her husband died, being taken a day or two after his death.

Dr. Vogt has seen many cases of malarial fever and three cases of congestive chill this summer. In the neighborhood of Rice's dwelling the cases were very severe, especially in the neighborhood of the Rocky Branch sewer. He has no deaths to report from these cases.

DR. G. W. HALL, 3609 North Ninth street, states that he saw this case at Dr. Vogt's request on the morning of the day the patient died. Rice had been sick three or four days, and had been seen by Dr. Vogt only a few times. When first seen by Dr. Hall, the patient was generally yellow, very much so; indeed, more so than Dr. Hall had ever seen in a case of bilious fever. The eyes also were yellow and the conjunctivæ injected. The man had been vomiting, but was not doing so at 9 A. M., the time of Dr. Hall's visit. During the night he had vomited matter which his wife described as being dark. Had had some dark offensive stools, with which the bed linen was stained; respiration was slow and irregular; the pulse feeble and slow; he was perfectly insensible, and there was complete suppression of urine; had been unconscious ever since 4 P. M. the preceding day. The patient was addicted to liquor, but was not a regular sot, indulging in excess only occasionally. His wife had prevailed on him to allow her to keep his drink for him in the house, and she gave him a certain quantity when he insisted upon it, so that he was never intoxicated upon the streets. She knew that he had taken nothing for three or four days before his attack. The patient, Rice, died the evening of the day (Sept. 13th) that Dr. Hall saw him, completely comatose.

It was not possible to trace this case to any other one already sick of yellow fever, but the patient's wife, who soon became convinced that he had yellow fever, stated that her husband had been among persons, not long before, who had recently arrived from the South, quite a number of whom, refugees from Southern cities where yellow fever was prevalent, and persons of a low class, living in the neighborhood of Union Market. She knew her husband had been a good deal with them. It could

not be learned that Rice had been on board of any steamer from the South. Dr. Hall is sure the case was one of yellow fever, and was promptly convinced of this when he made his visit, although barely expecting the case to be of that character until he saw it. After the visit, both Dr. Vogt and himself concurred in the opinion that it was a case of yellow fever, and accordingly notified the Board of Health.

The neighborhood is very malarial, and is not far from the opening of Rocky Branch sewer, which has been referred to by Dr. Vogt as very offensive. Two or three days before this man died, a woman died in the same neighborhood with symptoms similar to his, who had also been about these men who had come up the river from the South, and were living in the neighborhood of Union Market.

Dr. Hall states that according to his observation, the malarial fevers of last summer were unusually severe and difficult to manage; he observed more discoloration of an icteroid character than ever before. He found that he could seldom dispense with calomel, and was obliged to administer quinine in unusually large doses.

THE FEVER IN CARONDELET.

The steamer John D. Porter is stern-wheeler, employed as a tug-boat in conveying barges laden with coal, iron-ore and coke, between Pittsburg, the landings on the Ohio and the Mississippi from St. Louis to New Orleans. She is often at Carondelet (southern extension of the city of St. Louis) in the service of the iron works on the river margin at that point She is usually at Carondelet, this time of year, (April) once in ten days or two weeks.

The disastrous trip of this steamer late in July and in the early part of August up the Mississippi will be long remembered. On that trip she stopped at Vicksburg, en route for Pittsburg, on Wednesday, July 24th, and put off two men sick with yellow fever. Both of these died in a day or two at the Marine Hospital at that city. After the Porter left, a fireman, named Wilson, died of yellow fever on board of her at 3 A. M. on Thursday morning, July 25th, and the Porter returned to Vicksburg to bury him. She was allowed to put off her dead man, and also a man sick with the fever, and was then ordered away, the captain having promised to burn the bedding on which

Wilson had lain, and to disinfect his boat. Receiving information of these facts, the Board of Health at Memphis, where there was no yellow fever as yet, took effectual means to prevent the steamer from landing, which, apparently, she did not attempt to do.

Continuing her way up the river in quest of her barges, the Porter arrived at Cairo, where she was reluctantly allowed to land on July 21st, and to remain long enough to have some work done on her boilers. She then left for Carondelet, arriving there on the 3d of August, 1878, at 4 or 5 o'clock P. M. She remained over night, and from six to ten of her crew, mostly colored, were either discharged or quit without leave, going up a block or two from the point at which she lay, viz., at the foot of Market or Grundy streets, and entering a tavern or saloon on the east side of Main street between Fillmore and Ellwood streets. This saloon was kept by the Vincent family, two of whom afterwards died at their home near by, as will be detailed. Several of these roustabouts are also known to have entered the next store south of Vincent's saloon, kept by a man named Schweig, where there was also a bar. Mohring, who subsequently died, was frequently in this bar-room, and was seen there in company with these discharged men by Mr. J. Seeboth, who keeps an eating house and saloon, a little south of opposite, in a house where Mohring was subsequently found dead of yellow fever. The steamer Porter does not seem to have brought any barges with her, but came directly up to Carondelet from the lower river to get her barges which had been left at Carondelet to be unloaded some weeks before, and while here was obliged to ship one or two men. A letter from the captain on this point is subjoined:

OFFICE OF CUMBERLAND TOW BOAT CO.,
STEAMERS JOHN PORTER, IKE HAMMITT AND BARGES,
PITTSBURG, SEPT. 13TH, 1878.

C. * *

DEAR SIR:—Yours of 3d to hand; contents noted; would have replied sooner but have not been able to come to the city. Below find replies to your questions: I shipped an engineer, Dan'l O'Neal, at St. Louis; also one deckhand. I suppose there was about fifteen of the crew continued up the Ohio from New Orleans; I shipped some new men at Cairo. The engineer from St. Louis, Dan'l O'Neal, died at Gallipolis, O. The deckhand, from St. Louis, I believe, left the boat at Louisville. I have since understood O'Neal had been running to New Orleans pre-

vious to shipping on the Porter. We don't think we contracted any additional fever at St. Louis. Trusting you may derive the information you seek, I remain, yours etc.,

W. C. MAHAN.

The men who quit the Porter, after carousing awhile in the saloons on Main street, took the horse-cars and went up to St. Louis. None of them are known to have remained behind, and it is, perhaps, absolutely certain that none of them remained and sickened of yellow fever. There is no trace whatsoever to be discovered after most diligent inquiry of any sequence of cases between those on the Porter and those occurring about the middle of September, at Carondelet, within one or two hundred yards of the spot where the Porter lay. Some persons are known to have gone on board the Porter while she was at the landing, but no clothes for washing or other material was taken out of her, as far as could be ascertained, the steamer lying at the bank, scarcely one hundred yards from Main street, a very short time, not less than six hours nor more than twenty-four.

After this, we lose sight of the Porter for a week or so, until, having stopped at Cairo and taken on some hands, she landed at Louisville, August 12th, with several cases of yellow fever on board. On August 15th she passed Cincinnati with several cases on board, and was not allowed to land. The Health Officer boarded her below Lawrenceburg, and found her in a disabled condition. She was not allowed to land at that city, two physicians being detailed to go with her to Pittsburg, her destination.

On August 19th, the Porter lay at her moorings, one mile below Gallipolis, O., until the health officer compelled her to drop down below the bend. At that date there were ten cases on board, and three deaths within a few days. The further history of this steamer does not concern the subject matter of the committee's inquiries.

It will be seen that the steamer arrived directly from the South, having had deaths by yellow fever on board within a week, although when visited by the police at Carondelet no cases of fever could be detected. That she was thoroughly infectious is proved by the death of O'Neal, the engineer, and by the outbreak of yellow fever in the Ohio River, so that it must be assumed that, while at St. Louis, the boat and her crew were without doubt most intensely infected. On its being announced

by police telegraph that the Porter had landed at the foot of Market or Grundy streets in Carondelet, at the Health Commissioner's Office, Drs. Jameson and Homan were sent down at once, but on arriving saw her in the stream on her way. She was known to be thoroughly infected, and would not have been allowed to remain or come higher up the river, had she attempted to do so. These are all the facts that can be gleaned with reference to the visit of the Porter to Carondelet.

On the 17th of September, 1878, the first death of a series of eleven or twelve, most or all of which were indisputably yellow fever, occurred. The facts with reference to them have been obtained from the books of the Health Office, from statements made by Dr. L. S. Reber, who was acting during the summer of 1878 as Inspecting Officer for Carondelet, under the Health Department, from several of the local practitioners, and from many persons living in Carondelet, acquainted with the deceased, and by personal visits of the committee to the houses in which the deaths occurred, where persons were found who were cognizant of the dates, symptoms, etc., of each case. The committee has been at much pains to obtain reliable information with regard to this most interesting group of cases, and what is detailed below may be regarded, as far as facts are concerned, as entirely correct. The cases are arranged in the order of death; they all died:

CASE I.—Mrs. Mary Enwright, married, age 35, native of Ireland; residing near the corner of Second and Grundy streets. Diagnosis, "Hepatitis;" attending physician, Dr. Perry E. Noel. Died September 17th. She was sick eight days. Black vomit was seen to run out of her mouth. She was buried very suddenly.

CASE II.—Mrs. Tennessee Constant, æt. 52, born in the United States; residing on the corner of Main and Grundy streets; attended by Drs. H. M. Starkloff and E. E. Webster. Diagnosis, "Febris gastrica perniciosa." Died September 22d, 1878.

Mrs. Constant was a very large woman. Dr. N. L. Hornsby informs us that Dr. Webster, who attended her towards her death, affirms that she had black vomit some time before death. Capt. O'Neil, of the police, states that when she was placed in the coffin and her arms were pressed down in putting on the lid, the black vomit ran out of her mouth. This statement is confirmed by the

undertaker (Herye) who buried her. She was taken with a chill, and died after a sickness of four days and a half, taking to her bed on Tuesday, night, September 17th, and dying on Sunday morning following.

CASE III.—Lawrence Quinn, single, æt. 23, born in the United States; place of death, between Third and Fourth, on Kansas street. Attended by Dr. N. L. Hornsby. Died October 9th.

DR. HORNSBY contributes the following notes of this case: I was called about 8 o'clock on the evening of October 7th, 1878, to see Larry Quinn. Upon investigation I ascertained the following history of the case: His age about 22 years, a common laborer; had been occupied for several months past in the country, about five miles from the city; had been complaining occasionally through the summer, but with no serious sickness; had had chills a year or two previous. On the evening of the 5th October had a decided chill, which passed off through the night, leaving him tolerably well the next day. It being Sunday, he went grape-gathering in the woods. In the evening, about twenty-four hours from the last, he had a second chill, with intense pain in the head, passing into partial coma, in which condition he was on the night of the 7th, when I first saw him. I diagnosed the case as congestion of the brain from malarial poisoning, and treated it accordingly by topical bleeding, epispastics to the extremities, small and repeated doses of calomel, etc. I omitted to mention that he suffered from the time I saw him, with frequent attempts at vomiting, which towards the close became dark, resembling the coffee ground ejections of yellow fever. He lived only about twenty-four or thirty six hours after I first saw him. The stupor passed into complete coma, in which condition he died. After death the yellowness of the skin was striking, but not more so than is often observed in grave cases of malarial poisoning complicated with biliary engorgement.

N. L. HORNSBY, M. D.

From the police we learn that Quinn undoubtedly had black vomit; that he had been working at the Nazareth Convent, about three-fourths of a mile just west of the Quarantine grounds, when the wards were at the time full of yellow fever patients.

It is not likely that Quinn went in person to Quarantine for any purpose, but one of the nurses who had left Quarantine was also employed at the same Convent while Quinn was working there. Some of the people from Quarantine also went to mass at this Convent until the practice was suppressed.

Upon inquiry on the spot, and from Lawrence Quinn's mother, we learn that he had been much exposed to cold, being constantly wet for nearly ten days, during a period of a week or so before his attack. The house at which Quinn died *was not the one where the disease was contracted.* He had been living with his mother, in the southernmost of four small houses in a block or row opposite Ninth street, on Kansas, on a declivity in a vacant lot. He lived here some months immediately previous to being taken sick, and when attacked, on Sunday, the 7th of October, returning by way of the thoroughfares of the town, was so ill that he could get no further on his road directly out to his house than the house noted as his "place of death." A description of the premises in which Quinn was living when he was taken sick will be given further on.

CASE IV—Mrs. Mary Wilson, æt. 56, born in the United States, widow; residence on Third street, between Ellwood and Fillmore streets; no physician attending. Seen after death by the Coroner, Dr. H. Auler. Cause of death recorded as "Congestive fever." Died October 14th. From inquiries at the house in which she died, we learn that Mrs. Wilson was taken sick with a chill on October 10th, and that she died after a febrile attack, lasting but four days.

CASE V.—Mrs. Knight, mother to Mrs. T. Constant, residing in the same house, viz., at the corner of Main and Grundy streets; æt. 76; born in Virginia; attended by Dr. P. E. Noel; diagnosis, "old age and bilious fever;" died October 17, 1878. Her case is stated to have been a prolonged one.

CASE VI.—Henry Mohring, æt. 50; born in Germany; residence on Main, between Ellwood and Fillmore streets; not attended by any physician; he was seen, after his death, by the Coroner, Dr. H. Auler; cause of death recòrded, "bilious remittent fever;" died October 18, 1878. M. J. Seeboth, now residing in the house in which Mohring died, states that Mohring indisputably had yellow fever. His symptoms were great prostra-

tion, with uncontrollable nausea and vomiting; pain in the back and head; flushed face; duration of his attack being just four days; that during the latter days of his sickness he vomited black vomit profusely. His room was on the second floor, looking south, over Fillmore street, over a vacant space not more than one hundred yards from the house in which Mrs. Constant and her mother, Mrs. Knight, had died. Mr. Seeboth, as already stated, affirms that he saw Mohring in the company of the men discharged from the Porter, and also, later in the season, with two men from the South, who had reached St. Louis by steamer, and had come down to Carondelet. Mohring, to his knowledge, had never been in contact with any case of yellow fever.

CASE VII.—Mrs. Philomena Vincent; married; æt. 32; residing on the corner of Second and Fillmore streets; attended by Dr. N. L. Hornsby; diagnosis, "hepatitis and gastritis"; died October 20th; death certificate signed by Dr. Perry E. Noel.

Dr. Hornsby communicates the following with regard to her case:

"I was called early in the morning of Sept. 23d* to see Mrs. Vincent, Jr. She had been complaining slightly of general malaise, but was taken suddenly that morning with feeble pulse, coldness of the extremities, intense nausea, and occasional vomiting. The bowels were natural. There was pain in the back, but not intense; there was none in the head. The case was diagnosed as one of malignant malarial poisoning, and treated accordingly with small doses of calomel (gr. ij–iij) and bismuth, every two hours, with a large blister over stomach and bowels, mustard to the extremities, and gr. xv of quinine, with 15 drops of laudanum, every three hours, in starch enema. She recovered in forty-eight hours. There was no remarkable jaundice of the skin, nor was there black vomit. This patient, her husband tells me, had not been to see, or in any way connected (either before or after their death) with any of those who were sick in the neighborhood. She was taken sick, about two weeks after, with similar symptoms (her husband tells me), of which she died.

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*Dr. Hornsby admits that he kept no notes of the case, and writes from memory. The above date is obviously erroneous, as the date of death given is transcribed from the register of the Health Office and is certainly correct.

Her mother-in-law died about the same time, from all I could learn, from nervous shock, having been in delicate health for several months from malarial poisoning." This case is the next subjoined.

CASE VIII.—Mrs. Mary Vincent; living in in the same one-story house with her daughter-in-law, Mrs. Philomena Vincent; widow; æt. 68; native of France; attended by Dr. P. E. Noel; diagnosis, congestive fever, typho-malarial; died October 20th. The house adjoins, in the rear, that in which Mrs. Mary Wilson died, on October 14th. Mrs. Vincent, Jr., and her mother-in-law, kept the saloon at the corner of Ellwood and Main streets, their residence being just one block west of the saloon, with which they were in frequent communication. It will be recollected that the crew of the Porter entered the saloon when they left the steamer, and remained in it, and in the house adjoining on the south, some time before leaving for the city. This was, however, no less than forty-seven days before Mrs. Vincent's death.

CASE IX.—George W. Pilcher; æt. 12; born at Carondelet; residence, Second street, between Market and Grundy streets; seen by Drs. McElhiney and L. S. Reber; sent to Quarantine, and died October 22d.

DR. McELHINEY, 804 Brooklyn street, St. Louis, makes the following statements with regard to this case:

Dr. McElhiney was appointed, by the Health Commissioner, General Inspector of cases of suspicious fever, early in August, 1878, for the city of St. Louis. When a report was made to him of the existence of such a case, his duties required him to visit the patient, and to decide upon the propriety of a removal to Quarantine, if the case was, in his opinion, one of yellow fever.

About the middle of November, 1878, notice was given him by Dr. Reber, of Carondelet, Local Inspector of the Health Office, that there was a case in Carondelet supposed by him to be yellow fever. Dr. McElhiney at once went down to Carondelet, and found the patient to be a boy, 12 years old, named G. W. Pilcher. He had been born in St. Louis, and was in good health before his attack, not having been known to have intermittent or other form of malarial fever. The house he was in

was of one story, with two rooms, built back in a yard. Young Pilcher was in the front room of the house, at least sixty feet from the street. The boy had been taken with a chill, some two or three days before, and had black vomit when Dr. McElhiney saw him. There was flushing and relaxation of the face; great capillary torpor; injection of the conjunctivæ, and total suppression of urine; some yellowness of the body. He was semi-comatose, greatly oppressed, not heeding anything going on around him. He was at once sent down to Quarantine by ambulance, and Dr. McElhiney went with him. The boy died the next day. The case was unmistakably one of yellow fever.

CASE X.—Amelia Pilcher, æt 6, residence, 2d between Market and Grundy Streets; attended by Dr. Otto Fick. Diagnosis, "typho-malarial fever." Died Oct. 21. With regard to this case, Dr. McElhiney states that in the same room in which this boy G. W. Pilcher lay dying, he saw this girl laid out for burial; she had died that morning. She was said by the mother to have had the same symptoms, including black vomit, present in the boy, her brother. On drawing down the covering from the child's body, and making pressure upon the region of the stomach, a black fluid was seen to run down the cheeks from the corners of the mouth, quite freely. Her skin was very yellow. Dr. McElhiney says he had not a particle of doubt but that the case had been one of yellow fever, and so stated to those around at the time. The girl had been born in St. Louis, and had never been out of the city. These two cases were the last which Dr. McElhiney saw in 1878. He inquired carefully from the mother and neighbors, whether at any time during the season there had been any kind of communication between these two children, and any case of yellow fever, or known source of infection; but was told that nothing of the sort had happened, as far as they knew.

CASE XI.—Mary Enwright, æt 15 years, native of England. Place of death on Ellwood Street, between Third and Fourth streets. Attended by Dr. P. E. Noel. Diagnosis, "typho-malarial fever." Died Oct. 27th. By inquiry on the spot, we learn that the patient was not residing in Carondelet, but came down to see her mother ill at the time, about Sept. 15th, and with the rest of the family moved away from the house in which

her mother died to a residence a square and a half up the hillside to the north-west, where she continued to reside until taken sick. This house is within a couple of hundred feet of that in which Mrs. Wilson died on Oct. 14th.

A young man from the South, is said to have died on Sept. 4th, in a dwelling back of the "Widow's Home."

Not one of the eleven cases above noted, had had any *known* contact with a case of yellow fever, except with each other, and none had been to the South, being residents of Carondelet for years past.

Four of the cases occurred directly west of the point at which the Porter landed, and between the same two streets, viz., Grundy and Market Streets, between which the steamer was moored. Two of these cases, viz., Mrs. Constant and mother, lived on the corner of Grundy and Main streets, only one square from the point at which the steamer had been moored. The other three, viz., Mrs. Pilcher's two children and Mrs. Enwright, resided a hundred yards further west on Second street, between Market and Grundy streets, across an open lot. The house in which Henry Mohring was found dead by the Coroner, was two squares north-west of the point at which the Porter lay.

Mrs. Vincent and mother, and Mrs. Wilson, seen dead by the Inspector, and reported by the Coroner, resided in the square next adjoining, three squares to the north-west of the landing. Miss Enwright died in a house on Ellwood street, a short distance from the residence of Mrs. Wilson.

All these cases, except that of Larry Quinn, consequently occurred within an area not exceeding three blocks distance from the river front, in any direction. This can be seen on the accompanying chart of that part of Carondelet where the Porter touched, and these cases occurred.

After these events, inasmuch as the visit of the steamer Porter to Carondelet was supposed to have been too long, before the first of the cases, to be considered the source of any of them; and other known opportunity of contact between these cases and boats, or refugees, not being demonstrable, much difference of opinion was expressed as to their real nature. A meeting was at length called of the physicians of Carondelet, and held at the office of Dr. N. L. Hornsby, Oct. 26th, 1878, "for the purpose of ascer-

taining and investigating the causes, diseases and conditions which led to a certain mortality in our midst, and purported to be yellow fever." Dr. Purkett was elected Chairman; Dr. Outten Secretary. A committee was appointed to make an investigation and report to the meeting, consisting of Drs. N. L. Hornsby, W. B. Outten and S. C. Martin.

The following is a copy of the report of the committee, to which four additional names are attached:

GENTLEMEN:—Your committee to whom was referred the investigation of the disease prevailing in Carondelet at this time, and supposed by some to be yellow fever, would beg leave to submit the following report:

Having studied the cases in all their phases, they do not think they can properly be characterized as yellow fever, for the following reasons: It cannot, so far as we, each individually, have been able to learn, be traced to contagium as a factor in a single instance; whereas, yellow fever, as its history will show, invariably proceeds from contagion. Although the steamer Porter stopped at Carondelet, and some of its passengers or crew came ashore, and hence, by some it has been supposed to be the source of the disease. Your committee, *however*, deem that impossible, as that occurred in July, whereas, the malignant form of disease to which reference has been made, did not appear amongst us 'till September—too long a period for incubation to have existed. Although the symptoms of the disease, as headache, pain in the back and gastric irritability, are the symptoms of yellow fever, still they are invariably recognized as the symptoms also arising from malarial poisoning. Even the jaundiced color, considered pathognomonic of yellow fever, and which, from having been observed in one or two of the cases of the prevailing disease, has seemed to justify their being classed as such, is often found to occur in the most pernicious forms of malarial poisoning. Again, the season of the year in which the disease is prevailing, warrants our concluding that it is not yellow fever; as it conflicts with the history of all epidemics of the disease, that it should continue after the occurrence of frost.

In none of the cases of which your committee are cognizant, either by observation or inquiry, could they learn that contagion was a factor. They occurred in the Northern, Southern and

Western portions of the city, isolated from each other, and from any possible source of contagion, except the steamer above alluded to. This fact alone is sufficient to preclude all idea of yellow fever, as contagion is universally recognized as the source of the latter disease, and which the successful quarantining of some cities within the infected district has fully verified.

All the cases brought to the notice of your committee are explicable, in all their phases, upon the theory of malarial poisoning; and they deem it unphilosophical to introduce extraneous causes to explain phenomena, which can be readily explained by causes known to exist. For all of which reasons your committee are decidedly of the opinion, that the cases of disease referred to them for investigation, have arisen from malarial poisoning, and of a very pernicious type, and are entirely independent of the contagium of yellow fever.

N. L. HORNSBY, M. D.
W. B. OUTTEN, M. D.
S. C. MARTIN, M. D.
JOS. MIDDLETON, M. D.
E. E. WEBSTER, M. D.
A. MONTGOMERY, M. D.
C. PURKETT, M. D.

With regard to the statements made in this report, we beg leave to say, that after due reflection and according to the most reliable information we have been able to obtain, we feel ourselves obliged to class six of the eleven cases of fever above noticed or detailed, as undoubtedly yellow fever, viz.: Mrs. Mary Enwright, Mrs. Constant, Lawrence Quinn, Henry Mohring, G. W. Pilcher, Amelia Pilcher. The other cases were unusually violent and presented a malignancy altogether unusual in bilious fever. It must be recollected that some of the cases occurred in the same houses in which one of the cases had previously died, and others were developed in neighboring houses, separated from each other only by vacant lots. The entire group of cases evidently constituted a local outbreak, which only the lateness of the season prevented from extending further, and it is but rational to conclude that all the cases were of one common malignant type, and, consequently, that they were all more or less pronounced cases of yellow fever. In many of the cases of yellow fever already detailed as occurring in St. Louis, and even in the midst of epidemics at the South, black vomit has been wanting, in fact,

only a moderate proportion of fatal cases have this symptom; nevertheless there is no hesitancy among practitioners under these circumstances in classing such cases as yellow fever. This congestive type is thoroughly well known, and is an exceedingly fatal one—the patient often dying comatose, without vomiting or purging and even without marked febrile excitement—in two or three days. The committee, however, must limit themselves to general expressions of opinion, inasmuch as neither of its members saw any of these cases, and their judgment depends entirely upon a consideration of the symptomatology, as gathered from sources deemed reliable.

The fact that contagion cannot be distinctly traced from the steamer Porter, or from cases occurring in Carondelet, originally infected in the South, does not warrant the conclusion of the committee of Carondelet physicians, that these cases were not yellow fever. We do not admit that yellow fever is generated by contagion alone, but hold that, although without doubt contagious when developed, especially in the presence of a certain receptivity, which seems to be wrought by miasmatic influence in conjunction with heat and humidity, yellow fever is originally begotten by local causes, viz.: terrene and meteorological conditions, and that like all malignant forms of disease, it becomes contagious when once begotten, and precipitable by virtue of such contagiousness upon individuals and communities already subjected to conditions similar to those amid which it has already made its appearance, and we shall show further on, that conditions did exist in the area where these cases appeared, quite capable of originating yellow fever, independently of the steamer Porter, or any other source of infection or precipitation. Indeed the committee is strongly induced to agree with the signers of the report in question, to the effect that the visit of the Porter was too long before the appearance of the first case, viz., about forty-one days, to sanction any assumption that these cases were due to the Porter's visit directly or remotely. We have given all the facts with regard to the discharge of the crew and their communication with some of those who afterwards died, but do not nevertheless intend to impute these deaths to such contact. This would be straining the point of contagion quite too much, in the presence of conditions of the most unhygienic character, exactly competent to produce yellow fever, already existing in the part of the town affected.

The Carondelet committee state that the late appearance of the disease warrants their conclusion that it was not yellow fever, "as it conflicts with the history of all epidemics of the disease that it should continue after frost." With this statement we are obliged to take issue, and we doubt very much if the framers of this paper would have ventured to express themselves in such terms in December, 1878, or in January, 1879, for it is well known that the disease lingered in the South long after frost, and even after two or three heavy frosts, numerous deaths having occurred in persons who had returned to their business after frost, thinking that all was safe. Yellow fever is generated by *heat*, humidity, and the putrescent miasms of animal origin, in cities almost exclusively, but in exceptional instances, in the country also. When *once generated*, in the hotter part of the season, it can extend by its contagiousness late into the cooler weather, just as it may extend by transportation far to the North into cooler regions. And the first of these cases did really appear about the middle of September, when the heat was very high, the temperature for the week ending Sept. 7th, being 77.4, nearly what it was in the middle of August, the entire month of August having been unusually hot, its mean temperature being 79.17, or three degrees higher than its mean for the past five years, and higher than any of the previous four years.

With regard to cases of fever occurring as the report states, in the northern, southern, and western portions of Carondelet, we do not propose to say anything, for no details of any cases so occurring, with symptoms analogous to those presented by the cases detailed, have come to our knowledge. We propose to deal entirely with these eleven cases, all of which occurred within a few hundred yards of each other, and without exception, in the area fronting on Main street, between Ellwood and Lafayette streets, and which is backed by the hills, up to which these and the five intervening streets lead. Nor were these cases isolated from each other, but occurred on a gentle declivity in the bottom of a natural amphitheater enclosed by the rising ground behind, so that all foul drainage water, and, at night, all surface air, laden with various miasms, and with the proper infection of the yellow fever cases already existing on the hillside, necessarily flowed down upon those below, without even the intervention of buildings, for the area is mostly one of wide vacant lots.

So that, while admitting that these cases can scarcely be attributed to the Porter, we must again express our conviction that this consideration by no means invalidates our conclusions that they were yellow fever, and beg leave to say that contagion is not at all universally recognized in the South as the exclusive source of yellow fever, but only so by the extreme contagionists and specificists, a category to which your committee is happy to say, it does not belong. And in the same connection, we might remark that we do not know that quarantining of any cities in the infected districts of the South, in 1878, in any degree verified the assertion that contagion is the sole factor in the generation of yellow fever, for the fever invaded Mobile in September, one of the ports probably to which reference is made, and Galveston owes her immunity from the disease, not by any means to an assumed rigid quarantine, so much as to a happy combination of her meteorological conditions, notably the presence of a succession of thunderstorms all through July and August, and especially to a greater number of thunderstorms in August, 1878, than in the same month for any of the four preceding years. In Memphis, there *was but a single thunderstorm in the summer of 1878*, viz., in July, August, September, or October, and this *occurred in the second week in July*. The fever appeared on the 12th of August, after several weeks of great heat and atmospheric stagnancy.

We do not deny that these cases may have been based upon malarial poisoning, for we hold that yellow fever often shows itself as a malignant modification of commoner forms of fever, and this modification when occurring, viz., when yellow fever appears in any given locality, is due to contact either with the effluvia from yellow fever patients, or with fomites, or to the absorption of the putrid emanations of decomposing animal matter. That either the effluvia from the sick, or emanations of putrefaction, will at once cause the transformation of ordinary malarial fever into yellow fever, admits, in our judgment, of no sort of doubt. This proclivity to febrile disease, however, so readily begotten in the Mississippi valley, or the Gulf coast, and on the alluvial sites of the Southern Atlantic cities, needs only the touch of putrefying *animal matter*, to transform a bilious remittent into that continued form of bilious fever, now malignant (its old name), which we call yellow fever.

Having premised this much, we proceed to give a description

of the area in which this outbreak occurred, fortunately limited, by lack of material and by the lateness of the season.

Appended is a diagram of the area in which ten of these cases ran their course. (See diagram.)

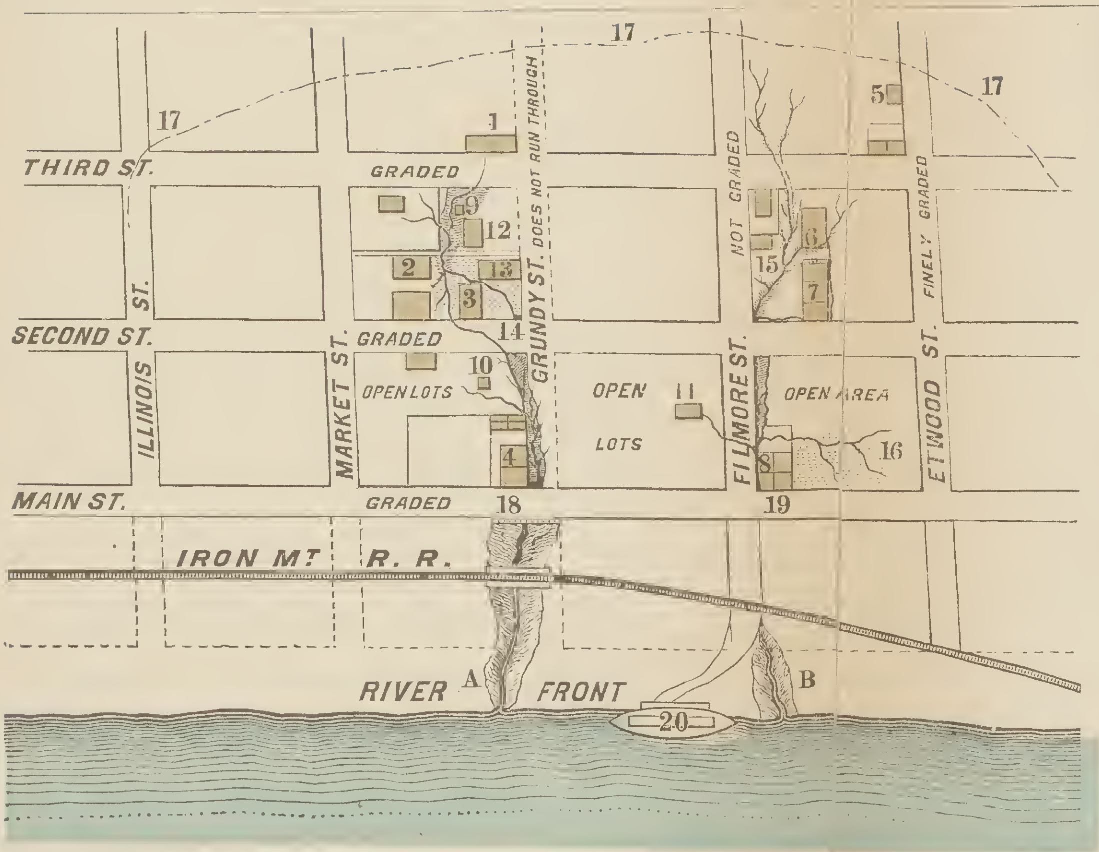
Standing in Carondelet, at the intersection of Grundy and Main streets, and looking north, we perceive that the surface rises rapidly, until within a distance of two or three squares only, an elevation of some fifty feet is attained. Towards the south there is likewise a constant, though more gentle ascent, and towards the west a rapid rise of the surface up to Fourth street, which lies on the crest of the river hills. Main, Second, Third and Fourth streets, lie north and south and are parallel to each other and to the river front. Ellwood, Fillmore, Grundy, Market and Illinois streets, are parallel to each other, running east and west, though not open at all places, and are nearly but not quite at right angles with the leading streets.

If we now walk around to the intersection of Grundy and Second streets, we see that we stand at a medium point of elevation in the middle of an amphitheater, with the river in front of us, the hills to our back, and rising ground to the north and south, and in the course or bed of one of the leads of the natural drainage of this amphitheater. One square further north, viz., at the corner of Fillmore and Second streets, we also find a hillside drainage lead, by which the washings from the vacant and occupied lots on Fillmore street are conveyed into the river. So that at these points, the drainage of all the lots and dwellings built in an irregular and straggling way up the acclivity is collected into two leads. There is no regular system of drainage whatever, and by each of these leads the water finds what course it may, except when reaching the streets running north and south, viz., Main and Second streets, under which it is conducted by passages of rough stone, to spread itself on emerging again, wherever it finds the lowest level.

There are thus two water leads from the back hills on this part of the amphitheater, designated A and B on the plat. *Along lead A five cases occurred, and the other five along lead B.*

It is important to note at this point that only the streets running north and south are graded and raised, being culverted a little below their surface, but by no means enough for the passage of all the drainage water under them. The drainage necessarily runs from west to east, while each of the north and south

PLATE II.



GUIDE TO DIAGRAM.

1. Laundry of Christian Brothers.
2. Mrs. Pilcher's residence.
3. Mrs. Enwright's residence.
4. Mrs. Constant and mother's res.
5. Miss Enwright's residence.
6. Mrs. Wilson's residence.
7. Mrs. Vincent and mother's res.
8. Henry Morhing's residence.
9. Privy.
10. Privy.
11. Stable.
12. Stable.
13. House.
14. Drain-hole; stopped up.
15. Area.
16. Undrained level.
17. Line representing the crest of the hills.
18. Point of lowest level for a mile on either side.
19. Point about the same level as 18.
20. Wharfboat.

A PLAN OF THE BASIN IN CARONDELET WHERE THE CASES OF YELLOW FEVER OCCURRED IN 1878.

streets being graded and considerably elevated above the areas immediately adjoining on the west, intercepts this tranverse drainage and dams back the water coming down the hill side. Especially is this the case at the intersection of Grundy and Second streets. Here we find quite a sort of terrace on which are situated the dwellings of Mrs. Pilcher and Mrs. Enwright. Around both of these dwellings, which are but little elevated above the soil, the hillside water collects, overflowing the entire yard and remaining on the surface until it dries up or is absorbed. Mrs. Enwright's house and room is not more than a couple of feet above the surface, and she was the first victim.

Lead A begins in the drainage from the premises and laundry of the Christian Brothers, (1) whence it passes through a small covered stone-ditch or culvert under Third street; this water was offensive when inspected at this point, early in April, 1879, by a member of the committee. As seen from the plan, it empties immediately into a deep and foul slough in a lot which receives the drainage of a stable, and the overflow from an old neglected privy almost directly in its course (9). This water then passes (and does so at *all times*,) across the alleyway, and runs into the open yard between the dwelling of Mrs. Pilcher and that of Mrs. Enwright, and a house twenty feet or so to the west of this (13). Here the drainage water, now contaminated, not only by the stable and privy already mentioned, but also by all the washings of the lots to the west and south immediately adjoining collects, being dammed back by the high grade of Second street. Its only outlet is in the direction indicated on the plan, in a circuitous way across a dead level, some hundred feet or so in extent, to the small opening at (14), when inadequate escape is provided under Second street, through an insufficient culvert now stopped up. Emerging by this culvert, on the east side of Second street, in conjunction with by far the greater part, which runs directly across the street, the water again falls into an irregular wash which occupies the area, through which Grundy street is surveyed, and passes on within twenty feet of the side of the Constant dwelling to reach the culverted passage under Main street, thence flowing into the river. The drainage from vacant lots on either side, and from a privy marked (10) is added to it. This drain from Second to Main streets consists of nothing more than an irregular and tolerably deep wash or shallow ravine.

It is thus seen that the terrace-like area on which the dwell-

ings of Mrs. Pilcher and Mrs. Constant are situated are liable to constant overflow; and to this point our attention was especially directed as the subject of much complaint by the parties now residing there. Nor is this water the uncontaminated surface washings of the hills but the drainage of neighboring lots, and the foul overflow of the filthy bog, into which the liquids of the privy marked (9), and of the stable (12), besides other accumulations of filth in neighboring premises, are constantly poured.

In the last week in August the rainfall was moderate (0.58 in.), while no rain at all fell in the first week of September, but there was a rainfall of no less than 2.05 inches in the week elapsing between September 7th and 14th. The premises in question were thus surrounded with foul water which lay upon the soil, making the lots so muddy that it was almost impossible to pass from house to house, and which emitted its humid and putrescent steams while drying up. Escaping from this area, in part, this foul water passed by the lead already described to stagnate in the shallow ravine directly under the windows of the Constant family.

Lead B begins near the southeast corner of Third and Ellwood streets, passes over broken ground around and in greater part directly through the premises where Mrs. Wilson died, to meet a series of small surface leads (15) by which the water escapes from the lots around. A portion of the lead passes directly in contact with the side fence to the north, and only a few feet from it, of the premises where Mrs. Vincent and mother died; and, as shown in the plan, runs around in front of the house and across an open area to the side drain on the north side of Fillmore street. Here it is joined by the water derived from leads (15), and courses on in an irregular ditch, through a nearly level area, just under the windows of the room in which Mohring died (8). Before doing so, it receives, first, the drainage from a large lot where a stable is situated, whence the water runs across Fillmore street to empty into the ditch, as shown; and, secondly, the back water from a low area (marked 16) to the north of Mohring's house, on Main street, which water, collected from neighboring lots, is forced to flow backwards to the west, and thence southward across the yard of the premises in which Mohring fell sick and died. Main street is thus seen to constitute a dam, by reason of the elevation of its grade, which prevents the passage of the drainage across it towards the river, thus causing the

water to accumulate and find its way through back-yards into the natural lead.

So much for the water drainage and overflow. It must be also recollected that there is another sort of drainage intimately connected with the development of miasmatic and epidemic diseases: this is the ærial drainage at night. After nightfall, in consequence of the cooling of the surface of the earth by radiation, the stratum of air in contact with it likewise sinks in temperature, and being now increased in density, flows downwards along declivities, always following the natural water-leads, or remains pent up behind obstructions, if the night is calm, just as in the case of the denser fluid, water. In its downward course along the declivities, it bears along with it all the noxious emanations from the soil and collections of filth, as water takes the soluble gases and admiscible matters from similar sources. Along the water-leads described, the natural air-drainage from the hillsides thus takes its course towards the lowest level—the river—and overflows the dwellings situated along them, or accumulates and remains more or less stagnant, during calm nights, in such areas as those we find around Mrs. Enwright's and Henry Mohring's dwellings. So that we have, in this way, a double source of inquination of the air at night: first, the emaations from the foul and stagnant drainage water and half-dried soil of neighbouring lots; and, second, the emanations from the declivities of this amphitheater poured into the air after nightfall, and borne on the gentle current of the falling air towards the sleepers along the natural water-leads, or else resting stagnant around their dwellings until the following morning.

In all these aspects, the dwelling of Mrs. Enwright, on lead A., was the most insalubrious; and just here we find the first death. On lead B, the dwelling of Henry Mohring was nearly, if not quite, as badly situated; and in this house we have one of the earliest deaths.

In Lawrence Quinn's case the conditions were wholly analogous. The accompanying plan shows the situation of the house in which he contracted the disease of which he died.

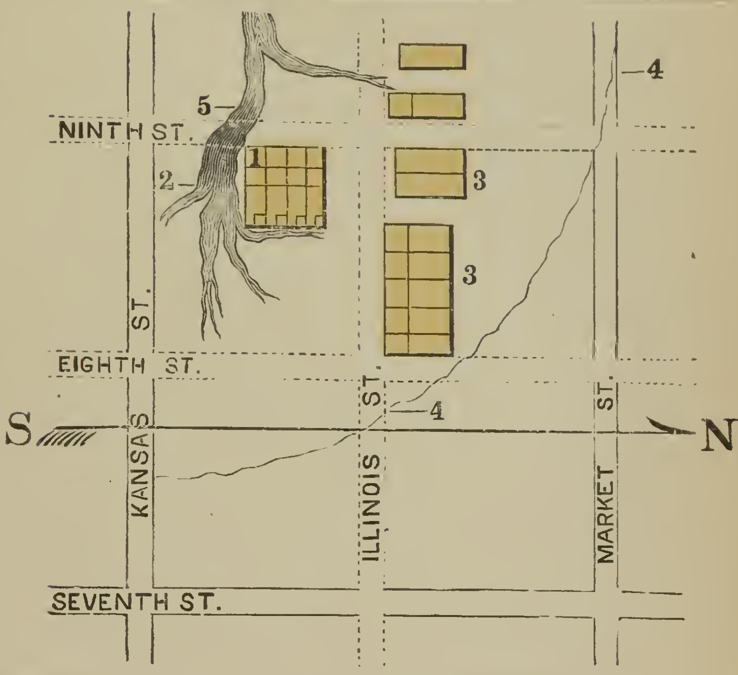
This was the southernmost of a block or tenement of four small, wooden, one-story houses, of two rooms each, situated in "Central Carondelet," between the line (Market street is not laid out at this point) of Kansas and Market streets, on the north, or where the street would fall if laid out. The houses

consist of a single building, two feet above the ground, separated from each other only by wooden partitions. Each house is provided with a privy without drainage. Under the easternmost or back-room of each house a cellar is dug, to a depth of five or six feet in the ground. All of these cellars contain water (May 29th), and did so likewise all last summer, as we were informed, to a depth of a foot or two. This water is the drainage and surface-scourings of the surrounding hill-slope. The houses lie in an open area, far down a gentle declivity, over which the rainwater flows from the yards of the residences around and higher up. The lead for all this drainage is shown on the plan (marked A). It consists of several washes combining together to make quite a ravine, which is twenty-five feet wide and about ten feet deep, just under the windows of Quinn's sleeping-room. Here the bottom of the ravine is wide, and trampled by cattle into a foul mud. None of these houses are occupied at this time (May 29, 1879), being regarded as very undesirable. Being exposed to the full effect of the sun, they are intolerably hot in summer,—not having a tree near them. Quinn's residence was therefore in a position in all respects analogous to that of Mohring's or Mrs. Constant's, viz., directly on the edge of a ravine-like drain, down which the water from the neighboring higher ground naturally flowed, and in which the filthy drainage was gradually dried up by the sun. Higher up the hill-slope, on the east, a cow stable was noticed, emitting even at this early period of the season a most noisome stench. It must be recollected, also, that the nocturnal aerial drainage, from the surrounding hillsides to the north and east, following the lead by which the water passes off, would likewise flow into and around the apartment in which Quinn lived. Nor must we neglect to consider the influence of the humidity begotten by several inches, at least, of water ("deep enough for fish to live in," as our informant stated when he showed us the premises) constantly present directly under three of these houses, and flowing off under Quinn's room by a ditch for the purpose leading into the ravine. In all these respects, we find a complete repetition of the condition of the premises in which the Pilcher children, Mrs. Constant and Mrs. Knight, Mrs. Wilson, Mrs. Vincent and her mother, and Henry Mohring had lived and died.

Mr. Enwright's death, on September 17th, was closely followed by that of Mrs. Constant's, on September 22d, too closely

PLATE III.

A PLAN OF THE SURROUNDINGS OF LAWRENCE QUINN'S RESIDENCE.



GUIDE TO DIAGRAM.

1. House in which Quinn lived.
2. Ravine directly adjoining.
3. Neighboring houses.
4. Line of the hill-top.
5. Lowest level.

to admit of any supposition of dependence of the second upon the first. It must be recollected that Mrs. Constant lived not more than 150 yards from the house of Mrs. Enwright, directly east and immediately below. The next case along this lead was Mrs. Knight, mother of Mrs. Enwright, who died on October 17th, having been sick some time. Five days after this, on the terrace near the head of this lead, the two Pilcher children died. Mrs. Wilson's death, on the 14th of October, was followed on the 18th by that of Henry Mohring, too closely to warrant any supposition of connection between the two cases, save that of nearly coincident affecting influences. Mrs. Philomena Vincent lived in the house immediately adjoining that of Mrs. Wilson, and a few feet lower down the hillside. Her death, on the 20th of October, and of her mother, likewise, may be fairly attributed to joint affecting influences of a miasmatic character, to contiguity to Mrs. Wilson, or to personal contact, perhaps. The case of Miss Mary Enwright, who died on October 27th, is perhaps attributable to contact with some of these cases, or to the *local causes.* She visited her mother while sick, but this was nearly six weeks before. The fact that the steamer Porter lay at the foot of Market street, would seem to have no necessary bearing upon the origin of these cases. Her doing so was probably, and indeed most reasonably, a mere coincidence. No cases occurred soon after her departure on August 3d, although diligent inquiries have been made on this point concerning persons known to have gone on board of her. This boat lay at the point indicated because a wharf boat is placed there, and the Missouri Iron Works are near by, and both the wharfboat and the works would seem to be located at this point in view of the general topography of the locality already referred to. Here, where the level is lowest and the water-leads empty naturally, is the most appropriate place for a landing, and for the location of works (situated, however, some squares down the river, at the foot of Kansas and Lafayette streets) which draw supplies of a bulky character from steamers, such as coal and coke, and iron ore from the railroad which lies between them and Main street. That the Porter should have landed at this point is just what she should naturally have done, and what she had done many times before, and has done nearly every two weeks since resuming her interrupted trade on the river. It is most reasonable to conclude, therefore, that her visit had no causative relation with the

cases detailed; at least we are in no way warranted in concluding to that effect in the face of the facts, which can be satisfactorily accounted for in quite a different way. An incubative period of forty-three days can scarcely be admitted, viz., from August 3d to September 15th, the probable date of Mrs. Enwright's attack.

No other supposition, finally, seems to be legitimately tenable than that the series of cases at Carondelet were purely of local origin, although it is not possible to affirm how far the individual cases affected each other. We have here a group of ten cases, seven of which (Mrs. Enwright on September 17th, Mrs. Constant on September 22d, and Mary Enwright on October 27th), occurred within *eight* days of each other, viz., from October 14th (Mrs. Wilson) to October 22d (Mrs. Pilcher's children.) Twenty-three days elapsed between the first two almost immediately consecutive cases, and the main group of eight cases all occurring in the third week of October. The advancing season arrested the further development and spread of the disease, the thermometer falling 9.3° between the 19th and 26th of October, (mean temperature for week ending October 19th, 61.5°, and for week ending October 26th, 52.2°), with a still further rapid decline of 10° more of *mean* temperature in the week ending November 2d, viz., to 42.2°. Miss Enwright's was the last case.

In Louisville, Ky., after the 27th of September, and up to the 19th of October, a series of local cases occurred, fifty or more, of which twenty-eight died (Dr. E. O. Brown's Report.) All these cases arose within a very limited area, immediately adjoining an alley which was excavated to the depth of two and a-half to five and a-quarter feet. In the language of R. T. Scowden, engineer, in the report cited, "the soil in the old alley way was more or less impregnated with putrescible matter from the absorption of liquid refuse and contaminations from decomposed house garbage." This excavation, undertaken to lower and correct the grade of an alley, involved interference with an open privy vault, which encroached upon the line of the alley about three feet. In the body of the alley, also, traces of three old privy vaults appeared from depressions in the ground. Here we have disturbance of the surface soil, and uncovering (at least) of privies in the face of the searching epidemic influences of 1878, things which are peremptorily forbidden in Southern cities during the summer months.

Louisville thus had her limited epidemic in October, from whatever causes arising. In Cairo, also, we find a late and lim-

A TABLE SHOWING THE PRINCIPAL FACTS OF THE FOREGOING THIRTEEN CASES OF YELLOW FEVER OCCURRING IN PERSONS WHOSE CONTACT WITH SOURCES OF CONTAGION COULD NOT BE DEMONSTRATED.

No.	Name.	Age.	Sex.	Nativity.	Residence.	Date of Attack.	Attending Physician.	Diagnosis.	Duration of illness	Termination.
1	A young man...........	22	Male.	Born in St. Louis.	Jackson, bet. Miller & Berry.	Aug. 17.	Carl Spinzig.	Yellow Fever.	6—8 days	Recovered.
2	—— Rice................	43	Male.	Germany.	Lindell ave. near Lindell Park.	Sept. 11.	E. A. Vogt & S. W. Hall.	Yellow Fever.	3 days	Died Sept. 13.
3	Mary Enwright..........	35	Fem.	Ireland.	Near 2d & Grundy sts. Carondelet.	Sept. 6.	Perry E. Noel.	"Hepatitis."	8 days	Died Sept. 17.
4	Mrs. Tenn. Constant....	52	Fem.	United States.	Cor. Main & Grundy sts. Carondelet.	Sept. 17.	H. M. Starkloff.	Febris. Gast. Pernic.	4 1-2 days	Died Sept. 22.
5	Mrs. Knight............	76	Fem.	Virginia.	Cor. Main & Grundy sts. Cardt.	Sept. 25.	P. E. Noel.	Old age and Bil. Fever.	22 days	Died Oct. 17.
6	Lawrence Quinn........	23	Male.	United States,	Cor. 3d & Kansas sts. Carondelet.	Oct. 5.	N. L. Hornsby.	Malarial Poisoning.	4 days	Died Oct. 9.
7	Mary Wilson............	56	Fem.	United States.	3d bet. Ellwood & Fillmore sts. Cardt.	Oct. 10.	Coroner's Case.	"Congestive Fever."	4 days	Died Oct. 14.
8	Henry Mohring..... ...	50	Male,	Germany.	Cor. Main & Fillmore sts. Carondelet.	Oct. 14	Coroner's Case.	"Bil. Remit. Fever."	4 days	Died Oct. 18.
9	Mrs. Philomena Vincent	32	Fem.	Unknown.	2d & Fillmore sts. Carondelet.	Oct. 16.	N. L. Hornsby.	"Hepatitis and Gastritis."	4 days	Died Oct. 20.
10	Mrs. Mary Vincent....	68	Fem.	France.	2d & Fillmore sts. Carondelet.	Oct. 16.	P. E. Noel.	"Congest. Fever Typho. Mal."	4 days	Died Oct. 20.
11	G. W. Pilcher..........	12	Male.	Carondelet.	2d bet. Grundy & Market sts. Cardt.	Oct. 18.	McElhiny & Reber.	Yellow Fever.	4 days	Died Oct. 22.
12	Amelia Pilcher.	6	Fem.	Carondelet.	2d bet. Grundy & Market sts. Cardt.	Oct. 18	Otto Fick.	Typho. Mal. Fever.	few days	Died Oct. 21.
13	Miss Mary Enwright....	15	Fem.	England.	Ellwood, bet. 3d & 4th sts. Cardt.	Oct. 22.	P. E. Noel.	"Typho. Mal. Fever."	5 days	Died Oct. 27.

ited epidemic. From notes kindly furnished by Dr. Charles W. Dunning, of that city, out of fifty deaths by yellow fever in Cairo between August 17th and November 2d, *thirty* occurred in the month of October.

We shall err on the safest side, viz., the hygienic one, by assuming that this group of cases in Carondelet was of the nature of a localized, and fortunately very limited epidemic, produced, as in other cities of this region of the Mississippi Valley, under the extraordinary pressure of the meteorological conditions of 1878, upon the basis of a bad sanitary condition of the premises involved. The evidence of contagion seems to be absent.

DR. L. S. REBER, who saw several of these cases, affirms that they were undoubtedly yellow fever, and Dr. N. L. Hornsby, in an interview with a member of the committee on the 29th of May, 1879, after a discussion of the subject, authorizes us to state "that the characteristic symptoms of several of these cases were in no respect different from those of yellow fever, and that in his opinion it is possible that the disease may have been communicated by the steamer Porter." In these opinions Dr. W. B. Outten, also a member of the Carondelet Committee, is willing to concur, and authorizes us to say further, that upon looking more closely into the history of the cases, their symptoms, and the locality in which they occurred, than he had been able to do at the time the Carondelet report was signed by him, he now (June 1st, 1879), has no hesitation in affirming that all of these cases were undoubtedly yellow fever. He is inclined to think they were due to contagion from the steamer Porter, disseminated either by the discharged crew or by other persons who had visited her. These cases, he further wishes to say, may have taken their origin in contagion conveyed by the unchallenged intercourse of persons living at Carondelet with Quarantine, some nine miles below, such communication, in numerous instances, being positively known to have taken place.

Annexed is a tabulated statement of the foregoing cases:

We append the following, as of interest with regard to the independent origin of yellow fever, and its relation to what is known as malignant swamp fever in the Southwest.

DR. J. T. HARRINGTON, No. 1429 Morgan St., communicates some interesting facts relative to certain cases of fever, either properly yellow fever or very closely simulating this disease. The Doctor states that he saw, between the 15th of August and 15th of Sept., 1878, in Chickasaw County, Mississippi, six cases, of of what his father, an old practitioner, called at the time *yellow fever*. The symptoms were pains in the back and head, nausea and great gastric irritability and epigastric tenderness. Two of the cases had black vomit and watery, exceedingly offensive black discharges per anum. One of the cases vomited bloody matter mixed with mucus. The two worst cases were much jaundiced, the conjunctivæ becoming very much tinged. The other four did not become distinctly yellow. The two worst cases had partial suppression of urine. Most if not all the patients had intermittents in June and July. They all recovered under heavy dosing with quinine. Morphine was not administered to any of them, chloral and Hoffman's anodyne being used to quiet their nervousness.

All these cases occurred in the persons of farmers residing at their homes, on three large creeks emptying into the Tombigbee river, within a radius of two and a half miles. The lower part of Chickasaw County, where these cases occurred, is very flat and swampy, commonly overflowed by rains and the rise in the creeks in the spring. The summer of 1878 was exceedingly hot and prolonged. There was no case of yellow fever in the season (1878) or formerly, as far as Dr. Harrington has heard, in Houston, the County seat of Chickasaw County. The Mobile and Ohio railroad is the only railroad which pases through the County, in which there are but two railroad stations, viz., Okalona, a town of four or five thousand inhabitants, and Egypt, a place where there only are some inconsiderable stores. Okalona is twenty miles distant from the neighborhood where these cases occurred, and Egypt twelve miles. There is no positive evidence that there were any cases of yellow fever either at Okalona or at Egypt, although such has been reported to have been the case. Dr.

Harrington does not think that either of the patients visited the railroad stations, although they did visit Houston. The patients had usually very filthy surroundings; living in log houses on the ground, in close proximity to stables and cattle pens. In addition to the bad smells that could be perceived after nightfall all through the country, Dr. Harrington distinctly observed, while sitting up at night, the smells of putrefaction emanating from filthy collections near the abode of the patients. Dr. Harrington is firmly of the opinion that these cases were identical in nature with the yellow fever of cities, and his father, who has practiced in Memphis and seen yellow fever there, declares that one of the cases was as well marked in every characteristic of yellow fever as any case he ever saw in Memphis.

At the time these eases were seen, intermittents, and especially remittents, were unusually prevalent; indeed, malarial fever of remarkable gravity and obstinacy prevailed everywhere through Chiekasaw County, and in all that part of the State. Dr. Harrington states that his father affirms that the malarial affections of 1878 in Chickasaw County, were more severe than any he had ever seen in that eounty during a practice of many years.

DR. W. H. FORD, 2945 Gamble St., relates the case of a Mr. Turney, at Kirkwood, Mo.

Turney was a young man, some 22 years, of age, clerk on a river steamer. About the 18th of August the boat touched at Memphis, where the yellow fever was prevalent at the time, and remained at the landing one night. Turney did not go ashore. Next morning the steamer went down the river and ascended White river in Arkansas, on one of her regular trips, to Newport. She was there moored in the stream, and Turney lived on board of her for two weeks, at the expiration of that time going ashore and living in a house on the bank or bluff. The water used by him was very bad, but there was nothing like yellow fever in the place up to Sept. 17th, when Turney left Newport for Kirkwood, Mo., by the Iron M. R. R. On his way up he was seized with a heavy chill followed by high fever. The fever did not remit, and there was no subsequent chill or rigor. Dr. Ford visited him at 6 P. M. on Sept. 19th and found him very sick.

The symptoms were constipation, injection and suffusion of the eyes, great prostration, temperature of 103°, pulse 100, or a little more. There was inappetence, but no nausea or vomiting. That night or next morning he bled smartly from the nose. Next evening, the symptoms were aggravated and there was a general disposition towards congestion of the surface. Quinine was given in doses as large as he could take, a drachm within twenty-four hours being ordered. The diagnosis was of malignant swamp fever. The citizens of Kirkwood however were so apprehensive with regard to his case, that he was sent down to Quarantine by ambulance, on the night of Sept. 30th. There he lingered for about three weeks, having hemorrhages by the mouth and bowels, and finally died. Both Turney and his friends positively asserted that he had not been in contact with any one sick of yellow fever, and when he arrived in Kirkwood he was in possession of a health certificate to that effect.

The following will be perused with interest:

DR. S. P. JOHNSON, 801 Franklin Avenue, states that he has seen several epidemics of yellow fever in the United States and in Rio Janeiro. The prevailing opinion in Rio Janeiro is that yellow fever is not contagious. The doctor saw many cases on board the shipping at Rio Janeiro, but all cases so occurring had had communication with the city when the disease was prevailing. A system of quarantine was in force, but was lax and was easily evaded. Back of the city, the land rises towards the hills, some two thousand feet high. At Laryngaris, 1,200 feet above the sea, and five miles from Rio Janeiro, and also at Petropolis, some 2,000 feet in elevation, across the bay, and forty miles from the city, the residents never contract yellow fever, except after a visit to the city. On the contrary, business men and residents of the city, who have taken the disease there, die when they leave the sea level and ascend to these heights. Cases of fever developed on the hills, in the persons of such individuals, invariably fail to extend among the residents of the hill country, who evince no fear whatever of the disease, nursing and visiting its subjects without any apprehension whatever, being well aware of their immunity. The Doctor states as his opinion, that the

immunity is entirely due to a lack of receptivity among the inhabitants of the highlands, where he has never known of a case of bilious fever, where the nights are always windy, and so cool even in midsummer, that it is necessary to cover with a blanket.

There is no sewerage in the city of Rio Janeiro, although from the inclination of the streets, the drainage is good; the streets also are well paved. Yellow fever is generally limited to the lower classes of the population.

Back of the city, the bay leads into a series of ponds where the slaughter-houses are situated. There is no provision made for the drainage of privies, which are pits sunk in the ground, as in Charleston and New Orleans. Near the mouth of a creek (Catette) which opens into the bay, he noticed a great accumulation of filth, which emitted a horrible stench. This material had been washed from the area, extending between the city proper and its suburb, Bota-Foga. Very little fever prevails in Bota-Foga, even when the disease is epidemic in the city. Bota-Foga is elegantly built up, and kept in unusually good hygienic condition, being for the most part a collection of suburban residences of the better classes, who live or do business in Rio Janeiro.

SECTION V.

CLASSIFICATION AND SUMMARY OF ALL CASES OF YELLOW FEVER OCCURRING IN ST. LOUIS AND ITS VICINITY, IN 1878.

	Recovered.	Died.	Total.
Cases of Yellow Fever treated in the city of St. Louis, in persons coming from points where the disease was prevalent	16	19	35
Cases of Yellow Fever treated at Quarantine, from all sources	59	38	97
Cases of Yellow Fever arising by contagion in St. Louis and suburbs, not treated at Quarantine	4	3	7
Cases of Yellow Fever arising by contagion in St. Louis and suburbs, treated at Quarantine	3	8	11
Cases of Yellow Fever, or closely simulating that disease—where contagion could not be demonstrated—occcuring in St. Louis and suburbs, not treated at Quarantine	1	11	12
Cases of Yellow Fever, or closely simulating that disease—where contagion could not be demonstrated—occurring in St. Louis and suburbs, treated at Quarantine	..	1	1
Cases of Yellow Fever treated in St. Louis, its suburbs, and at Quarantine, in the year 1878	80	71	151
Cases of Yellow Fever treated in St. Louis, etc., and at Quarantine, in persons from cities where the disease prevailed (exotic cases)	72	48	120
Cases of Yellow Fever arising in St. Louis and suburbs, in residents, or persons who had not been to the South (indigenous cases)	8	23	31

The number of deaths by yellow fever, imported and of domestic origin, occurring properly in the city of St. Louis and its suburbs, was thirty-three; of these, fourteen were indigenous cases, and nineteen from abroad. Thirty-eight deaths are also recorded at Quarantine, making a grand total of seventy-one deaths by yellow fever of domestic and extraneous origin conjointly.

The number of deaths by yellow fever of *domestic origin*, was twenty-three out of thirty-one cases; of which, nine deaths occurred at Quarantine, the patients having been removed thither, and fourteen in St. Louis and its suburbs.

CONCLUSIONS.

The general conclusions reached by the committee, are as follows:

1st. Yellow fever may be acquired in St. Louis, by contact with persons sick with that disease, and with the apparel of persons who have been in contact with the sick; by entrance into the holds or apartments of steamers, or by communication with their cargoes.

2d. Yellow fever, or at least an equally fatal disease in no way distinguishable from yellow fever, and like it, contagious, (Miss Enwright from the person of her mother,) may be generated *in loco* by bad sanitary conditions in this city and its suburbs.

3d. The population of St. Louis does not acquire the capacity of receiving yellow fever, until late in the season, viz., the end of September and month of October, in the great majority of cases.

4th. Individuals weakened by disease, and especially the subjects of malarial fever, evince the greatest readiness to acquire yellow fever by contagion.

5th. A sort of hybrid fever, characterized by intense and often repeated rigors, analogous to break-bone fever, (Dengue) may be acquired in St. Louis by contact with places or things which have been in relation with persons sick of yellow fever.

6th. For the prevention of yellow fever in St. Louis, the most rigid Quarantine possible should be established, with reference to cities in which yellow fever may appear, to be maintained until the month of November, or a permanent decline of the weekly mean temperature to 40°.

7th. Subjects of yellow fever at Quarantine, should be segregated there, and served by a special corps of attendants, who should not come in contact with any other patients.

8th. No disturbance of the soil, or rectification of drainage, should ever be practiced in the presence of yellow fever.

9th. The subjects of yellow fever should, if practicable, be promptly removed from the city and taken to Quarantine.

10th. All sanitary measures relating to the abatement of nuisances capable of causing disease, should be instituted and completed before the month of July.

11th. The cardinal property of yellow fever, so far as St. Louis is capable of being invaded by the disease, which has now been unfortunately proved, though on a very limited scale, is its indisputable contagiousness; but inasmuch as an acceptance of this contagion implies a certain receptivity previously wrought by meteorological influences in conjunction with the effluvia of putrefaction, still greater attention than ever should be paid to matters of drainage and general sanitation. Such action will constitute a safeguard to the public health, we are assured, more reliable than even a rigid quarantine, while in numberless other ways, it will conduce to the welfare of our city. All of which is respectfully submitted.

W. HUTSON FORD, M. D.
F. J. LUTZ, M. D.

HALL OF THE ST. LOUIS MEDICAL SOCIETY,
POLYTECHNIC BUILDING,
JUNE 1st, 1879.

The Report of the Committee having been presented to the Society, on motion of Dr. Thos. F. Rumbold it was accepted, and after some remarks by members, on motion of Dr. Thos. Kennard it was adopted by an unanimous vote, and referred to the Committee on Publication.

At a meeting held on the previous Saturday, May 31st, 1879, Dr. W. Hutson Ford was invited to prepare for publication a supplementary report on the meteorological conditions and etiology of sunstroke, malarial fever, cholera sporadica, and yellow fever, based on an analysis of the meteorological records of Saint Louis and ten other cities of the United States, which is hereto appended.

W. E. FISCHEL, Sec'y.

A REPORT

ON THE

METEOROLOGICAL CONDITIONS AND ETIOLOGY OF SUNSTROKE, CHOLERA SPORADICA, MALARIAL DISEASES AND YELLOW FEVER.

BY W. HUTSON FORD, M. D.

PART I.

The material at my command for the objects indicated above are as follows:

1st. Full abstracts of the meteorology of the City of St. Louis for the eighteen or nineteen weeks elapsing between the last week in June and the second week in November for each of the years 1874, 1875, 1876, 1877 and 1878. The figures are the weekly means and totals, and have been calculated from the books of the Signal Office in this city by permissiou from the Chief Signal Officer at Washington, and with the assistance of Sergt. Weber, in charge of the office in St. Louis. These figures comprise the sum of the clear and the fair days, the barometrical heights, the mean temperature, the mean temperature of evaporation or wet bulb temperature, the mean daily movement of wind, the rainfall, and the number of thunder-storms, and have been all calculated by myself, excepting the temperature, atmospheric pressure and rainfall for the years 1874, 1875, 1876 and 1877, with unusual precautions against error, and have been carefully revised.

As a record of atmospheric humidity the temperature of evaporation has been chosen instead of the dew point or the relative humidity, for the following reasons: Any other expression of the humidity is a *calculated* figure, because the direct determination of the dew point by any reliable form of hygrometer is a delicate and somewhat tedious operation, not adapted to the use of Governmental or municipal offices of observation. The instrument employed in the Signal Service and almost universally in municipal offices of registration, is the pair of coupled thermometers, one of whose bulbs is constantly wetted with water by capillary attraction, known as the wet and dry bulb apparatus. An observation with this instrument consists in simply reading the two thermometers. From this double reading, by appropriate calculation, or from tables, especially the standard ones of Glaisher, the figures expressing the conditions of atmospheric humidity are readily obtained, such as the weight of vapor in a

cubic foot of air, the relative humidity, the drying power, or the dew point. In an epidemiological point of view, absolute, and not relative figures, expressing the humidity, are desirable, and the expression should be one of *temperature*, either the dew point, or the direct reading of the wet bulb. The dew point itself relates to the temperature of evaporation, and as I have said, is in practice a *calculated* figure, while the indication of the wet bulb thermometer is a *direct* observation. This wet bulb temperature or temperature of evaporation, moreover, is so analogous to the temperature of moist surfaces of the earth or things upon it, and of the human body, which is wetted by its own secretions (perspiration) when the thermometer ranges high, or when the body is heated under exertion, that it becomes plainly the hygrometrical indication which ought to be studied in connection with heat and moisture as affecting the earth's surface and the human body. It is, therefore, altogether preferable in epidemiological researches to the dew point temperature, and although in former examinations like the present one, I have, in common with others, employed that figure, I shall not do so on the present occasion. Were the reasons already given not sufficient, it may be added that as the relative humidity expresses the *per cent* of moisture in a given volume or weight of air at *the temperature noted*, its figures may be high when the temperature is very low, or conversely; and its records do not, therefore, necessarily move in parallelism with the mean temperature, as is the case for both the dew point and wet bulb indication, and they cannot, consequently, be used for comparison with the temperature. I have, therefore, selected this figure, viz., the wet bulb indication, because it expresses the atmospheric humidity in a manner more exactly appropriate to the physiological necessities of an inquiry like the present one, than any other. As this has not been hitherto done, to my knowledge, the movements of this figure will be found worthy of especial attention.

2d. Full data of the weekly mortality in the City of St. Louis by cholera ("*sporadica*" and "*cholera morbus*"), malarial diseases, yellow fever and sunstroke, for the same four months of the warm season for which I have obtained the meteorological data for each of the past five years. These figures have been drawn by me in person from the books of the Health Office.

3d. The complete meteorology of ten additional cities, viz., Louisville, Cairo, Memphis, Vicksburg, New Orleans, Galveston,

Mobile, Charleston, Norfolk and Philadelphia, for the same periods of time for which the figures have been abstracted from the books of the Signal Office at St. Louis, viz., for each of the eighteen or nineteen weeks elapsing between the last week in June and the second week in November of each of the years 1874, 1875, 1876, 1877 and 1878. These data have been very kindly furnished, on application, by the Signal Office in Washington, D. C., and embrace *all* the years recorded under the system of that office in *all* the cities named. As they were received, the hygrometrical figures were expressed in terms of "relative humidity," as is the custom of the United States Signal Service; these figures I have translated, by appropriate calculation, with the aid of Glaisher's tables, for reasons already given, into terms of the wet bulb temperature.

4th. Two charts of the meteorology of St. Louis in reference to sunstroke, kindly prepared and presented by Sergt. J. H. Weber, showing the movement of the daily meteorological records for the month of July, 1878, and of the same month in 1874, to which I have added the necrology of sunstroke for the same period, as drawn by myself from the records of the Health Office.

5th. Special information obtained by correspondence with the Health Offices of the cities mentioned, and with private individuals, and a variety of printed publications of Health Boards, and of the National Board of Experts.

6th. The annual reports of the Chief Signal Officer, from 1874 to 1878.

The accumulation of this material, not by any means, or even approximately, as complete as it should be for a thorough examination of the subjects proposed, has necessarily consumed much time, and the laborious computation, for the determination of monthly and seasonal means, not contained in the annual reports of the Signal Officer, has occupied every moment I could spare during several months past. Much important matter which I had hoped to receive has not come to hand as yet, but so much time has passed that I am compelled to submit the following pages as they are, and in a far less complete condition and probative form than I would otherwise like to have done, especially, as regards an examination of the *calmness of the nights*, with reference to sunstroke and yellow fever. The meteorological figures required for this purpose have been applied for at Washington, but have not yet been received. I am not, therefore, able to present

them at this time, while I am confident they will be found to be most intimately associated with the etiology of sunstroke, and with the origin and extension of yellow fever. The fact itself of the relation of the calmness of the nights to yellow fever, I determined for Charleston, S. C., long ago, by a comparison of the indications of the *minimum* thermometrical record of the night with the dew point at each following *sunrise*; these figures I shall present in the second part of this report. The data in possession of the Signal Office, however, are direct, as they consist in an exact record of the number of miles traveled by the wind, and therefore portray all gradations of windiness from absolute calmness, upwards.

I now present the meteorological data and necrology of the City of St. Louis for each of the past five years, viz., 1874, 1875, 1876, 1877 and 1878. These years are all that have been recorded in the Signal Office, and are consequently all that are attainable for strict comparison with each other. Private records of meteorology have been made for many years previous to 1874, but are not comparable in their items with those of the Signal Office, as the observations have been taken at various points and by different methods, while indeed, in some important items these records are wholly defective. The five years considered for St. Louis, moreover, are the same as those for which the data have been furnished from Washington for ten other cities, and they are, therefore, strictly comparable with these last.

We also present with them a table of means and totals for each of the years, in which the weekly data have been reduced to those of the months for July, August, September and October, all of which again have been finally consolidated in a table of means of all the five years.

While collecting the necrological statistics I thought it might prove useful to determine the number of deaths by all diseases dependent upon heat, humidity and malarial influences, and have accordingly presented the weekly figures for sunstroke, malarial diseases generally, for yellow fever and for cholera. During the past five years in St. Louis, all deaths by cholera are found recorded as deaths by "cholera morbus" or "cholera sporadica;" these *fatal* cases of "cholera morbus" have seemed to me to be worthy of consideration in an epidemiological point of view.

Elevation of surf. of merc. in cistern of Bar. above sea level, 543.54. Latitude, 38°, 37′, 28″.

Population in 1874, 450,000. ST. LOUIS, 1874. Longitude, 90°, 15′, 16″.

Weeks ending.	July.				August.					September.				October.					Nov.
	4	11	18	25	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7
No. of clear and fair days	5	5	5	3	6	7	5	6	3	5	7	5	2	7	6	3	5	6	6
Mean barometer	29.958	29.930	30.036	29.949	29.970	29.977	29.967	30.011	29.914	30.067	30.017	29.981	30.067	30.005	30.068	30.220	30.141	30.115	30.058
" temperature	82.3	82.9	79.9	83.6	71.3	76.6	83.8	82.1	73.6	70.9	79.2	68.7	65.5	63.4	60.6	51.5	60.8	56.4	60.1
" wet bulb	69.9	71.5	69.3	73.3	66.5	67.7	71.7	69.7	68.5	65.0	70.0	61.6	59.8	54.0	52.4	44.8	53.7	50.1	50.1
" (daily) movement of wind	181.5 (mls.)	194.8	209.1	200.4	211.9	173.8	190.8	181.4	209.7	175.3	166.8	246.9	147.4	180.5	182.6	195.4	127.9	281.0	316.6
Total rainfall (inches)	0.12	0.62	1.91	2.71	0.64	1.14	0.58	0.49	2.29	0.04	0.00	0.86	0.71	0.00	0.00	0.54	0.56	0.00	0.11
No. of thunderstorms	1	*	1	*	*	*	*	1	*	*	*	*	*	*	*	*	*	*	*
No. deaths by remit. etc., fevers	3	1	..	1	7	2	2	5	[illegible]	2	5	5	1	6	4	0	3	1	4
" " yellow fever	..	..	.	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
" " sunstroke	1	6	1	4	7	..	9	1	..	..	..	..	..	..	..	..	.	..	..
No. deaths by cholera sporadica	2	9	5	1	3	2	6	..	..	..	..	..	..	..	..	..	..	..	..

* No Thunderstorms recorded.

Elevation of surf. of merc. in cistern of Bar. above sea level, 543.54 ft. Latitude, 38°, 37′, 28″.

Population in 1875, 498, 182. ST. LOUIS, 1875. Longitude, 90°, 15′, 16″.

Weeks Ending.	July.					August.				September.				October:					Nov.
	3	10	17	24	31	7	14	21	28	4	11	18	25	2	9	16	23	30	6
No. of clear and fair days	3	5	5	3	1	6	6	6	7	7	5	6	7	6	5	5	7	6	5
Mean barometer	29.955	30.158	29.990	29.957	9.971	29.978	29.885	29.968	30.096	29.974	30.040	30.090	30.184	30.004	30.055	30.126	30.119	29.852	29.965
" temperature	75.6	78.6	81.4	75.5	76.7	72.0	73.9	71.2	73.2	79.1	75.4	65.4	55.4	61.5	59.9	46.9	56.9	56.9	48.0
" wet bulb	70.5	72.3	74.6	70.2	72.6	65.1	65.8	63.5	65.6	72.0	68.0	58.5	47.7	52.9	52.5	40.5	45.9	48.8	41.8
" (daily movement of wind.	193.1 (mls.)	175.2	177.1	148.6	191.7	248.4	174.4	173.7	211.2	172.6	205.7	189.6	185.2	246.9	261.8	217.2	231.8	374.8	219.4
Total rainfall (inches)	1.16	1.58	0.32	3.22	3.66	0.43	0.08	1.11	0.65	0.39	0.05	0.07	0.00	0.19	0.51	0.01	0:00	0.64	0.00
No. of thunderstorms	*	1	*	1	*	*	*	*	*	*	*	*	*	*	*	*	*	1	*
No. deaths by remit. etc., fevers	3	2	..	1	4	4	6	6	4	13	10	6	23	17	25	15	14	6	4
" " yellow fever	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
" " sunstroke	1	..	..	2	..	..	..	.	..	..	1	..	..	..	..	..	..	..	..
" " cholera sporadica	.	3	1	2	1	1	..	.	1	1	1	1	..	..	..	..	..	1	..

* No Thunderstorms recorded.

Elevation of surf. of merc. in cistern of Bar. above sea level, 543.54 ft. Latitude, 38°, 37′, 28″.

Population in 1876, 500,000. ST. LOUIS, 1876. Longitude, 90°, 15′, 16″.

	Weeks Ending.																		
	JULY.					AUGUST.				SEPTEMBER.					OCTOBER.				NOV.
	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4
No. of clear and fair days	2	5	4	7	6	6	5	6	7	6	6	2	5	4	6	6	5	5	4
Mean barometer	29.910	29.935	29.951	30.037	30.023	29.975	30.024	29.940	30.058	30.030	29.905	30.053	29.881	30.117	30.005	30.024	29.912	29.957	29.966
" temperature	75.9	80.6	80.8	83.7	73.4	77.0	77.5	80.4	77.4	73.8	77.6	62.9	67.6	58.5	51.4	51.0	56.4	57.5	59.9
" wet bulb	70.7	73.2	75.0	74.7	65.6	68.6	73.2	75.6	69.3	66.3	71.2	58.1	62.8	52.5	44.4	43.2	46.8	48.8	53.0
" (daily movement of wind	217.5 (mls.)	264.5	170.8	157.5	185.0	173.8	199.0	151.8	184.2	174.5	185.0	190.3	124.0	177.0	225.5	213.8	266.4	256.8	293.4
Total rainfall (inches)	4.97	2.49	0.54	1.09	1.07	0.57	0.84	2.53	0.00	3.05	3.64	0.21	1.67	0.00	0.04	0.09	1.50	0.03	0.11
No. of thunderstorms	*	*	*	1	*	*	*	1	*	2	2	*	*	*	*	*	1	*	*
No. deaths by remit. etc., fevers	1	2	2	5	2	2	3	5	5	6	16	16	21	15	10	10	10	7	4
" " yellow fever	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
" " sunstroke	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..
" " cholera sporadica	3	1	3	1	..	..	1	..	..	..	..	..	1	1	..	..	..	..	..

* No Thunderstorms recorded.

Elevation of surf. of merc. in cistern of Bar. above sea level, 543.54 ft. Latitude, 38°, 37′, 28″.

Population in 1877, 500,000. ST. LOUIS, 1877. Longitude, 90°, 15′, 16″.

	Weeks Ending.																	
	JULY.				AUGUST.				SEPTEMBER.					OCTOBER.				NOV.
	7	14	21	28	4	11	18	25	1	8	15	22	29	6	13	20	27	3
No. of clear and fair days	4	6	5	4	7	5	7	3	6	4	4	6	5	5	5	2	4	4
Mean barometer	29.952	29.972	29.921	30.002	29.988	29.909	29.946	29.927	30.070	30.067	29.877	30.058	30.019	30.035	30.061	29.937	29.932	29.995
" temperature	83.3	78.0	73.7	77.5	79.0	75.9	73.9	72.3	80.1	66.8	72.4	66.5	72.8	65.2	58.1	64.0	57.0	50.1
" wet bulb	74.5	67.0	65.5	70.1	69.8	68.0	65.0	64.4	71.4	59.4	66.7	57.3	66.1	57.9	52.3	60.8	52.3	44.6
" (daily movement of wind	230.0 (mls.)	183.5	213.8	168.1	175.0	179.7	176.1	167.1	199.8	125.4	180.7	148.5	169.0	191.2	237.1	218.4	197.8	271.1
Total rainfall (inches)	0.28	0.67	0.97	0.96	0.30	0.98	0.21	0.37	1.45	0.19	1.51	0.23	0.93	0.08	1.61	3.11	0.12	0.90
No. of thunderstorms	1	1	2	*	*	3	*	*	2	1	*	*	*	*	*	1	*	*
No. deaths by remit. etc., fevers	4	9	3	5	6	9	3	10	9	12	15	15	5	12	9	7	12	6
" " yellow fever	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
" " sunstroke	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
" " cholera sporadica	1	1	2	1	1	..	1	1	..	..	..	..	..	..	..	..	..	..

* No Thunderstorms recorded.

Elevation of surf. of merc. in cistern of Bar. above sea level, 543.54 ft. Latitude, 38°, 37′, 28″.

Population in 1878, 500,000. ST. LOUIS, 1878. Longitude, 90°, 15′, 16″.

	Weeks ending.																	
	JULY.				AUGUST.					SEPTEMBER.				OCTOBER.				NOV.
	6	13	20	27	3	10	17	24	31	7	14	21	28	5	12	19	26	2
No. of clear and fair days	4	6	7	5	5	6	6	5	5	7	5	7	5	5	5	6	5	7
Mean barometer	29.989	29.970	29.905	29.912	29.889	29.861	29.955	29.931	29.939	30.014	30.117	30.006	30.098	29.991	30.028	29.949	30.052	30.203
" temperature	75.3	85.9	88.3	79.0	80.8	80.8	77.9	82.9	74.4	77.4	64.9	69.6	64.4	67.9	63.6	61.5	52.2	42.2
" wet bulb	70.2	76.7	77.0	68.0	72.6	72.3	69.1	61.4	65.8	67.0	56.1	60.7	57.5	61.7	56.0	53.4	46.3	36.4
" (daily) movement of wind	194.7 (mls.)	159.5	169.5	235.5	187.2	174.7	137.1	193.8	182.1	137.2	240.8	244.8	244.5	244.8	210.2	360.5	276.8	305.5
Total rainfall (inches)	1.92	0.16	0.03	1.57	0.94	3.71	0.16	0.01	0.58	0.00	2.05	0.46	0.89	0.56	0.16	0.81	1.76	0.00
No. of thunderstorms	3	*	*	*	2	3	*	*	*	*	*	*	1	*	1	*	*	*
No. deaths by remit. etc., fevers	3	5	26	8	8	11	8	14	9	16	16	16	17	11	10	8	9	4
" " yellow fever	..	..	1	..	..	..	4	2	*1	5	*1	*1	*..	..	*..	*..	*..	*..
" " sunstroke	..	33	109	5	1	..	..	..	..	..	..	..	..	..	..	..	..	..
No. deaths by cholera sporadica	2	1	..	..	1	..	..	..	..	..	..	2	..	..	..	..	..	..
☞ Deaths by Indig. Yel. Fev.									*1		*2	*2	*1		*2	*7	*7	*1

*No Thunderstorms reported.

The asterisks denote the weeks in which the deaths indicated below by "Indigenous Yellow Fever," as established by the Committee, should be inserted. The figures in the table are those on record at the Health Office, and refer to deaths by imported cases mostly, although including a few that occurred in the city by contagion.

Let us in the first place examine the relations of sunstroke in St. Louis to the meteorological conditions.

In the year 1874 there were 29 deaths by sunstroke.
In the year 1875 there were 4 deaths by sunstroke.
In the year 1876 there were 2 deaths by sunstroke.
In the year 1877 there was 1 death by sunstroke.
In the year 1878 there were 148 deaths by sunstroke.

I shall consider only the first and last year of the series, these being the only years in which this affection assumed the proportions of what, for many reasons, might well be termed an epidemic.

In 1874, the deaths by sunstroke, were as follows, in the weeks ending

JULY.				AUGUST.			
4th.	11th.	18th.	25th.	1st.	8th.	15th.	22d.
1.	6.	1.	4.	7.	0.	9.	1.

In 1878, they occurred as shown below, in the weeks ending

JULY.				AUGUST.
6th.	13th.	20th.	27th.	3d.
0.	33.	109.	5.	1.

No deaths by sunstroke occurred in these two years at any other time. In abstracting these records, only the titles, sunstroke, insolation, coup de soleil, exhaustion and apoplexy from heat, have been considered as sunstroke. Entries in which the nature of the case was not distinctly stated, *have not been counted.*

ST. LOUIS. MEANS AND TOTALS.	Total — Total clear and fair days.	Mean — Barometer.	Mean — Temperature.	Mean — Wet Bulb.	Mean — Wind in twenty-four hours, miles	Total — Rainfall, inches.	Total — Thunderstorms.	Total — Deaths by Remittent Fever.	Total — Deaths by Yellow Fever.	Total — Deaths by Sunstroke.	Total — Deaths by Cholera, etc.
1874.											
July	21.00	29.980	81.5	70.25	206.7	5.71	1.57	12.7	.....	15.0	18.6
August	23.29	29.969	78.3	69.00	189.7	4.70	1.00	16.6	.....	14.0	8.4
September	21.57	30.029	70.2	62.69	184.2	2.32	.....	15.8	.....	.....	.....
October	23.09	30.127	58.1	50.58	195 1	1.09	.....	10.5	.....	.....	.. ..
Whole Season.	88.86	30.026	72.05	63.38	193.9	13.82	2.57	55.6	.....	29.4	27.0
1877.											
July	22.00	.9.959	78.4	69.32	.99.8	2.88	4.00	23.6	.....	1.0	5.4
August	24.10	29.961	76.0	67.40	179.3	2.61	4.70	33.1	.....	.....	2.6
September	20.61	30.004	69 8	62.52	158.7	3.56	1.28	50.0	.....	.....	.....
October	17.53	30.000	.59.6	54.31	219.5	4.92	1.00	41.4	.....	.....	.....
Whole Season.	84.21	29.981	70.95	63.39	189.3	13.97	10.93	148.1	.....	1.0	8.0

ST. LOUIS. MEANS AND TOTALS.	Total — Clear and Fair days.	Mean — Barometer.	Mean — Temperature.	Mean — Wet Bulb.	Mean — Wind in twenty-four hours, miles	Total — Rainfall, Inches.	Total — Thunderstorms.	Total — Deaths by Remittent Fever.	Total — Deaths by Yellow Fever.	Total — Deaths by Sunstroke.	Total — Deaths by Cholera, etc.
1875.											
July	15.29	29.965	78.2	72.24	175.1	9.49	2 00	8.4	.....	2.4	7.0
August	28.00	20.983	73.1	65.68	199.1	2.66	.....	25.6	....	.....	2.4
September	26.29	30.000	67.2	59.06	199.6	0.24	.....	58.5	.....	1.0	2.6
October	25.42	30.041	54.7	47.14	268.1	1.23	1. 0	65.4	.....	.....	1.0
Whole Season.	95.09	29.997	68.30	61.03	210.5	13.62	3.00	157.9	.....	3.4	13.0
1878.											
July	18.63	29.935	82.31	72.69	189.3	3.93	3.69	45.72	1.00 *1	147.0	3.27
August	24.14	29.918	79.17	67.03	173.4	4.86	3.86	45.82	7.00 *5	1.0	0.43
September	25.42	30.068	68.99	60 41	218.6	3.56	1.00	68.13	7.00 *17	.....	2.00
October	24.57	30.038	57.79	50.98	279.9	3.13	1.00	37.73	.....	.....	.....
Whole Season.	92 76	29.990	72.06	62.78	215.3	15.48	9.55	197.43	15.00	174.99	5.70

*Indigenous Cases.

ST. LOUIS. MEANS AND TOTALS.	Total — Clear and Fair days.	Mean — Barometer.	Mean — Temperature.	Mean — Wet Bulb.	Mean — Wind in twenty-four hours, miles	Total — Rainfall, Inches.	Total — Thunderstorms.	Total — Deaths by Remittent Fever.	Total — Deaths by Yellow Fever.	Total — Deaths by Sunstroke.	Total — Deaths by Cholera, etc.
1876.											
July	24.00	29 976	79.2	71.85	193.8	5.90	1.00	11.70	.....	.....	5.4
August	26.58	29.998	77.8	71.01	176.9	5.03	2.43	18.70	.....	2.0	1.0
September	18.71	29.995	66.8	61.49	169.4	7.63	2.57	69.71	.....	.....	1.0
October	23.28	30.000	55.7	46.17	245.7	1.66	1.00	38.72	.....	.....	.....
Whole Season.	92.57	29.992	69.87	62.63	196.4	20.22	7.00	138.83	.....	2.0	7.4
Means of all Recorded Years.											
July	20.18	29.963	79.92	71.27	192.9	5.58	2.45	20.42	1.00 *1	33.10	7.93
August	25.22	29.965	76.87	68.02	183.7	4.96	2.40	27.96	7.00 *5	1.47	2.97
September	22.52	30.019	68.59	61.35	186.1	3.46	0.97	52 43	7.00 *17	0.20	1.12
October	22.74	30.041	57.18	49.84	241.7	2.41	0.80	38.75	.....	.....	0.20
Whole Season.	90.66	29.999	70.65	62.62	201.1	15.42	6.62	139.55	15.00	34.77	12.42

*Indigenous Cases.

RELATION OF SUNSTROKE TO TEMPERATURE IN ST. LOUIS.

A.—The year 1878 in St. Louis.

The following table shows the temperature of the four weeks of July and the first week in August in St. Louis, for all the recorded years:

YEARS.	July. 1st week.	July. 2d week.	July. 3d week.	July. 4th week.	August. 1st week.
1878.	75.3	85.9	88.9	79.0	80.8
1877.	83.3	78.0	73.7	77.5	79.0
1876.	75.9	80.6	80.8	83.7	77.0
1875.	75.6	78 6	81.4	75 5	72.0
1874.	82.3	82 9	79.9	83.6	77.3
Means.......	78.5	81.2	80.9	79.9	77.2

From this table it is seen, that in the first week in July, 1878, the temperature was below its average—there were no deaths by sunstroke. In the second week, the temperature suddenly rose more than ten degrees, to a point 4.7° above the proper mean of that week, and there were 33 deaths by sunstroke. In the third week the temperature rose three degrees higher, as the mean of the week (maximum of July 17th, 98.5), to a point eight degrees above its mean, with a sunstroke mortality of 109. In the fourth week the temperature suddenly fell 9.9 degrees, to a point .9 of a degree below its average for that week, and the mortality likewise declined to 5, while in the last week of the epidemic, that ending August 3d, the temperature again rose 1.8°, to a point 3.6° above the common mean of that week, and there was but one death—the last of the season.

The temperature of the week ending July 6th, 1878, 75.3°, was below its mean; that for the ensuing week, ending July 13th, was the hottest in five years, except that for the following week, ending July 20th. The only other week on record (in the Signal office) in St. Louis in which the temperature approached that of these two weeks, was the week ending August 15th, 1874, when the temperature reached 83.8°, with the maximum mortality by sunstroke *of that season.*

The progress of the sunstroke epidemic may therefore be stated as follows: While the temperature was at or below its average, there were no cases of sunstroke; when the temperature rose suddenly to an unprecedented figure, the epidemic

began; when the temperature rose still higher, the mortality reached its fearful maximum; and upon the sudden declension of the temperature to a point below the average, the epidemic also suddenly declined, and notwithstanding a rise of temperature again somewhat above its mean, became wholly extinct. The parallelism of the mortality with the movements of the temperature while this was abnormally high, is absolute, and indisputably shows the dependence of sunstroke upon atmospheric heat, as *one* of its prime causes.

In the following table the same weeks of 1878 are compared for the eleven cities:

	Week ending July 6.	Week ending July 13.	Week ending July 20.	Week ending July 27.	Week ending August 3
St. Louis	75.3	85.9	88.9	79.0	80.8
Louisville	78.7	83.1	86.5	77.9	81 8
Cairo	77.1	83.9	89.1	80.4	82.9
Memphis	77.8	84.4	89.0	82.5	84.1
Vicksburg	78.9	82.4	86.1	85.7	82.4
New Orleans	81.0	84.2	84.9	85.5	84.8
Galveston	82.4	84.5	86.1	85.5	85.5
Mobile	81.7	82.6	86 5	86.3	84 7
Charleston	80.8	83.6	82.2	83 5	85 3
Norfolk	79.7	84.3	83.1	80.3	82.2
Philadelphia	79.6	76.4	79.6	76.5	74.3

By inspection of these figures, we perceive that the rise of temperature from the first to the second week was greater in St. Louis, by far, than in any of the other ten cities, thus:

	Difference of Temperature between 1st and 2d weeks of July, 1878.	Difference of Temperature between 1st and 3d weeks in July, 1878.
St. Louis	+10 6	+13.6
Louisville	+4.4	+7.8
Cairo	+6 8	+12.0
Memphis	+6.6	+11.2
Vicksburg	+3.5	+7.2
New Orleans	+3.2	+3.9
Galveston	+2.1	+3.7
Mobile	+0.9	+4.8
Charleston	+2.8	+1 4
Norfolk	+4 6	+3 4
Philadelphia	—3.2	0.0

By examination of the records, I also find that this rise of temperature is absolutely without parallel for any of the fifty-five seasons of which I have the figures. Thus, the greatest rise of temperature between any two consecutive weeks in all these fifty-five summers (viz.: 5 summers for each of 11 cities), is as follows:

Between the 1st and 2d week of July, 1878, in Memphis, a rise of 6.6° of *weekly* mean temperature, viz., 77.8° to 84.4°.

Between the 1st and 2d week of July, 1878, in Cairo, a rise of 6.8°, viz., from 77.1° to 83.9°.

Between the 4th week in July, 1877, and the 1st week in August, 1877, in Vicksburg, a rise of 7.2°, viz., 77.6° to 84.8°.

Between the 2d and 3d week of August, 1874, in St. Louis, a rise of 7.2°, viz., from 76.6° to 83.8°.

These are the most considerable of the *per saltum* movements of the weekly mean temperature to be found. That of the year 1874, in St. Louis, just noted, coincided, as will be shown further on, with the maximum of deaths by sunstroke for that year, in St. Louis.

The mortuary annotation for the rise in 1877, in Vicksburg, although applied for, has not been communicated, and so also for Memphis and Cairo, much to my regret.

It will be seen from the figures that in the year 1878, a very rapid rise of temperature occurred in the first three weeks of July, beginning in New Orleans. This was not expressed in Galveston, Charleston, Norfolk, or Philadelphia. This increase of temperature attained its maximum *more suddenly* and by a greater range of increment in St. Louis, than in any of the eleven cities, viz., from 75.3° for the 1st week in July, through an increment of 10.6°, to 85.9° for the second week, or through an increment of 13.6° to 88.9° for the 3d week of July, 1878. The point of departure in St. Louis, viz., 75.3° (1st week of July), was 3.2° *lower* than the average for that week, while as we have shown, the temperature of the second week was 4.7° higher than its proper mean, and that of the third week 8 degrees above its mean.

Hence, we conclude that the suddenness of the rise of temperature in St. Louis in July, 1878, from an unusually low grade to an unprecedented high one in the second and third weeks of that month, was a primary factor in the production of sunstroke. It will also be noticed that the temperature in the 2d week in July was higher by 1.4° than in any of the eleven cities, and, probably, any city of the United States, while that for the 3d week of July yielded only to that of Memphis by 0.1°, and of Cairo by 0.2°. Let us now examine the *humidity* for the same weeks of 1878 in St. Louis.

The following table shows the wet bulb temperature or humidity of the four weeks of July and the first week of August in St. Louis, for all the recorded years:

YEARS.	JULY. 1st week.	2d week.	3d week.	4th week.	AUGUST. 1st week.
1878.	70.2	76.7	77.0	68.0	72.6
1877.	74.5	67.0	65.5	70.1	69.8
1876.	70.7	73.2	75.0	74.7	66.6
187 .	70.5	72.3	74.6	70.2	72.6
1874.	69.9	71.5	69.3	73.3	65.6
Means.......	71.2	72.1	72.3	71.3	69.4

From this table we see, by the means, that the humidity normally progresses from the first to the third week in July, attaining its maximum in this week. We also perceive that, as in the case of the temperature, the humidity for the first week in July was below its mean (one degree), and that it suddenly rose by an increment of 6.5°, to a point 4.6° *above* its proper average in the second week; thence, in the third week, by an increment of 0.3° more, to 77.0°, a figure no less than 4.7° above its proper mean, while from the third to the fourth week, the humidity declined more suddenly even than it had risen, through a decrement of nine degrees, to a point lower than the proper mean of the week by 3.3°, rising from this figure through 4.6° to a point 3.2° above the mean of the first week of August. In all these movements the same strict parallelism with the mortuary records of deaths by sunstroke, noted for the temperature, is observable.

It will also be perceived that in the second and third weeks of July, 1878, the absolute maxima for these weeks, of all the recorded years, were reached in St. Louis. By examination of the figures it will be moreover seen that these weeks were the most humid that have occurred in St. Louis for five years, no other weeks, even in 1874, approaching them in this respect.

In the following table of humidities these first five weeks of the season of 1878 are compared for the eleven cities.

	Week ending July 6.	Week ending July 13.	Week ending July 20.	Week ending July 27.	Week ending August 3.
St. Louis........	70.2	76.7	77.0	68.0	72.6
Louisville.......	71.8	74.7	75.6	65.5	71.6
Cairo..	72.8	78.0	80.4	71.4	76.4
Memphis.... ...	73.2	76.9	79.2	73.5	76.8
Vicksburg	74.6	76.6	77.8	77.1	78.0
New Orleans....	75.5	77.0	76.5	78.2	78.2
Galveston	76.2	78.4	78.6	7 .9	80.0
Mobile	77.	76.1	77.7	79.2	79.3
Charleston	74.4	76.7	77.1	76.6	79.3
Norfolk..........	73.3	75.1	74.5	70.3	76.2
Philadelphia ...	70.7	69.8	71.4	64.8	67.5

We do not find, by this table, that the humidity in the second and third weeks of July were the absolute maxima, or nearly so, compared with the eleven cities, as was the case for the temperature, in St. Louis. But a due estimate of the degree of this humidity may be formed from the following table, which shows the relation of the humidity in 1878, in St. Louis, to its own common average, and to that for all the Southern cities whose records are at hand, expressed in means of all the recorded years:

	1st week in July.	2d week in July.	3d week in July.	4th week in July.	1st week in August.	Means of 2d & 3d w'k
Memphis.....	73.7	74.3	74.7	74.5	73.8	74.5
Vicksburg.....	75.1	75.1	74.9	75.2	75.4	75.0
Mobile	76.1	75.7	75.8	75.6	77.2	75.7
New Orleans..	75.2	75.6	75.3	74.7	77.2	75.5
Galveston	77.0	77.5	76.6	77.0	78.2	77.0
Charleston	76.5	75.7	77.1	76.8	75.9	76.4
Norfolk.... ...	73.8	73.0	74.5	74.3	72.3	73.7
St. Louis	71.2	72.1	72.3	71.3	69.4	72.2
St. Louis in 1878	70.2	76.7	77.0	68.0	72.6	76.8

It will be observed that, while the humidity of the first week of July, 1878, was below its mean in St. Louis, that for the second week of the season was greater than the average of that of any of the Southern cities of the United States, except the insular city of Galveston, which, we shall subsequently find, to be one of the most humid cities of the Union, falling short of this by 0.8 of a degree only. In the third week of July, the humidity of St. Louis, in 1878, was 77.0°, also greater than the common average for the same week of any but one of the Southern cities, including Galveston, and falling below that of the city of Charleston alone by 0.1 of a degree only. Charleston is an extremely humid city, being built very much like Galveston, upon a strip of land lying between two arms of the sea.

A still closer estimate is attainable by inspection of the means for the two weeks (second and third, of July week for all the years) conjointly, which will be found in the foregoing table. The humidity for this period of 14 days in St. Louis was 76.8°, greater by 0.4 of a degree even than that of Charleston, and less than that of Galveston, alone, which it failed to reach by only 0.2 of a degree.

The humidity of these two weeks, moreover, was 4.6° above the proper mean for St. Louis, and may be expressed in the statement that *during those disastrous two weeks, in addition to the*

highest temperature in the United States, the humidity proper to a semi-tropical city surrounded by water, and fanned by the warm and vapor-laden winds of the Gulf of Mexico, had been transferred from its appropriate territory, and precipitated upon the population of this city.

Let us now examine into the *suddenness of the rise of the humidity* in the early part of July, 1878, in St. Louis, as compared with previous years in the same city, and with the same year (1878) in the eleven cities. By inspection of the table on page 121, it is seen that the rise of 6.5° of humidity between the first and second week of the season was nowhere paralleled in any of the five years; and the same may be still more strongly stated for the difference between the first and third weeks, amounting to 6.8°. No increment greater than 6°, between any two consecutive weeks, has occurred in St. Louis in five years, and this but once, viz., between the weeks ending August 25 and September 1, 1877. In examining the fifty-five recorded seasons, I find, in the months of July and August, the following instances of sudden increase of humidity:

1st. From the third to the fourth week of July, 1877, in Louisville, a rise of 7.0°, viz., from 66.7° to 73.7°, the range of both figures being much below that of the weeks in question in St. Louis. The coincident change of temperature was from 74.1° to 79.7°.

2d. From the second to the third week in August, 1874, in Cairo, a rise of 7.1°, viz., from 69.1° to 76.2°, the coincident change of temperature being from 77.6° to 83.7°.

3d. From the second to the third week in July, 1876, in Cairo, a rise of 8.1°, viz., from 66.9° to 75.0°, the associated temperature being 72.9° and 80.5°.

4th. From the second to the third week in August, 1874, in Memphis, a rise of 6.5°, viz., from 69.8° to 76.3°, the coincident range of temperature being from 83.1° to 88.3°.

5th. From the fourth week in July to the first week in August, 1874, in Mobile, a rise of 10.7°, viz., from 65.4° to 76.1°, the associated rise of temperature being from 71.7° to 84.0°.

6th. From the fifth week in August to the first week in September, 1874, in Norfolk, a rise of 6.5°, viz., from 61.4° to 67.9°, the range of both figures being low, and associated with low temperature, with a rise, however, from 67.8° to 70.4°.

7th. From the fifth week in July to the first week in August, 1876, in Philadelphia, a rise of 6.5°, viz., from 59.8° to 66.3°, the associated temperatures being 71.2° and 69.9°, a declension of 1.3°.

These are the only instances of a rise of humidity of 6.5° or more than this, between any two consecutive weeks, to be found in the records. As there are 9 transitions from week to week in each year, five years for each city, and eleven cities, it is seen that, in about 495 transitions, we find but eight instances of such a rise, viz., about 1.6 per cent of the first ten weeks of all the seasons. In St. Louis the sudden rise was associated with a rise in temperature of 10.6°, viz., from 75.3° to 85.9°. In no other instance but one, viz., in Memphis, in 1874, was such a temperature approached, and this occurred late in the season, after the temperature had already stood high in July, the figures being 82.8° for first week, 81.4° for second week, 81.3° for third week, 87.1° for fourth week, and 80.9 for first week in August. Nor was there any associated saltation of the *temperature* for these *two weeks* approaching that which we find in St. Louis. Thus in Memphis it was 5.2°, while in St. Louis the rise of temperature (weekly mean, be it recollected), was 10.6°.

From the foregoing considerations, we perceive, 1st, that the rise of the humidity accompanying the development of the epidemic of sunstroke in St. Louis, in July, 1878, was a very rare meteorological phenomenon, viz., occurring only in 1.6 per cent of the weekly transitions; 2d, that the rise of humidity was paralleled in only seven instances, with none of which was any remarkable saltation of temperature associated, except in the case of Memphis.

Below I present a table showing the increments and decrements of temperature for the first four weeks of the season of 1878, and for the eleven cities:

	1st week	Dif. bet. 1st and 2d weeks.	2d week	Dif. bet. 1st and 3d weeks.	3d week	Dif. bet. 3d and 4th weeks.	4th week
St. Louis	70.2	+6.5	76.7	+6.8	77.0	— 9.0°	68.0
Louisville	71.8	+2.9	74.7	+3.8	75.6	—10.1°	65.5
Cairo	72.8	+5.2	78.0	+7 6	80.4	— 9.0°	71.4
Memphis	73.2	+3.7	76.9	+6.0	79.2	— 5.7°	73.5
Vicksburg	74.6	+2.0	76.6	+3.2	77.8	— 0.7°	77.1
New Orleans .	75.5	+1.5	77.0	+1.0	76.5	+ 1.7°	78.2
Galveston.....	77.2	+1.2	78.4	+1.4	78.6	+ 0.3°	78.9
Mobile	76.4	—0.3	76.1	+1.3	77.7	+ 1.5°	79.2
Charleston....	74.4	+2.3	76.7	+2.7	77.1	— 0.5°	76 6
Norfolk.......	73.3	+1.8	75.1	+1.2	74.5	— 4.2°	70.3
Philadelphia .	70.7	—0.9	69.8	+0.7	71.4	— 6.6°	64.8

It is seen that the sudden rise of humidity was never equalled, in 1878, in any of the eleven cities, while the sudden decrement of the humidity between the third and fourth weeks was only once equalled, and once slightly excelled.

B. The year 1874 in St. Louis.

In this year the period of mortality by sunstroke was greatly more prolonged than in 1878, extending over eight weeks. The mortuary figures, with the associated temperature and humidity, are given below:

	Weeks Ending							
	July.				August.			
	4th.	11th.	18th.	25th.	1st.	8th.	15th.	22d.
Temperature	82.3	82 9	79.9	83.6	77.3	77.6	83.8	82.1
Annual mean temperature	78.5	81.2	80.9	79.9	77.2	76.7	77.4	77 8
Wet bulb	69.9	71.5	69.3	73.3	66.5	67.7	71.7	69.7
Annual mean wet bulb	71.2	72.1	72.3	71.3	69.4	68.3	69.0	66.9
Number of deaths	1	6	2	3	7	0	9	1

In this year there were 29 deaths by sunstroke; but these were distributed over a space of eight weeks. Nothing approaching the mortality of 1878 occurred in this year. The highest figure reached on any given week was 9, while in 1878 it was 109. On any given day, viz., on the 7th of July, the number of deaths was 4, while on the 14th of July, 1878, the number reached 34. The intensity of the "epidemic," therefore, being so greatly less than in 1878, the corresponding meteorological figures and movements ought likewise to be greatly less pronounced.

We find, by referring to the table above, that the temperature of the first week was 3.8° above its mean, with one death. That of the second week was also above its mean by 1.7°, with a mortality of 6. In the third week the temperature fell a degree below its mean, and there was but one death. In the fourth week it rose again to 3.7° above its mean, and the mortality began to increase, and reached a total of 7 in the following week, notwithstanding a declension of the temperature to a point but very little (0.1°) above its mean. The temperature remaining at this figure (0.9° above its mean, only), there were no deaths in the week ending August 8th. In the following week, however, the third most remarkable rise of temperature that has ever

occurred in St. Louis between any two consecutive weeks., viz., 6.2°, took place, and 9 deaths for this week, the maximum for the season, are recorded ; while on the declension of the temperature, in the following week, by 1.7°, the deaths fell to 1, and the sunstroke period came to a close. The march of these figures clearly shows the influence of temperature upon this affection, and especially of rapid increments and decrements of temperature in causing an immediate increase and diminution of the mortality, respectively.

Throughout the first three weeks in July of this year, the humidity was below its mean, and this was doubtless one reason why the mortality was no greater, for as I shall show by charts of the daily movements of these figures, the extremes actually reached by the temperature were higher by far than in 1878, while the humidity never rose comparatively to as high a grade. As soon as the humidity, in the week ending July 25, 1874, rose to 2.0° above its mean, the mortality began to increase, the temperature having also risen, and in the two following weeks, the humidity having fallen to a point below its mean, the mortality ceased, seven deaths, however, being recorded for the week ending August 1st; three of which occurred on August 26th, before this declension.

From the second to the third weeks in August, there was a rise of the humidity to a point 2.7° above its mean, associated with the very remarkable rise in temperature already spoken of, and we find that the mortality at once rose to the maximum of the year, viz., nine. In the ensuing week, both temperature and humidity declined ; the latter by 2.0°, and the epidemic came to a close.

Although the figures are not so pronounced as in 1878, the mortality being only one-ninth as great on the maximum day, and one-twelfth as great in the maximum week, there is, nevertheless, a very close parallelism to be observed. The influence of extraordinary heat and humidity, especially when coming on suddenly, and early in the season, before the human system has become habituated to such conditions, which in the natural and more equable march of the seasons, invade it gradually, is still more distinctly shown on the charts of these two years which I now present:

These charts have been carefully prepared for my use by Sergt. J. H. Weber, of the Signal Service, in charge of the office in this city, from the government records. The lowest line, indicating the march of the mortality by sunstroke, I have drawn myself from the figures of the health office. Each chart shows the maximum temperature, the mean daily temperature, the wet bulb temperature, the barometrical height, the fairness of the sky, the amount of rainfall, and the number of deaths by sunstroke for each day in the month of July.

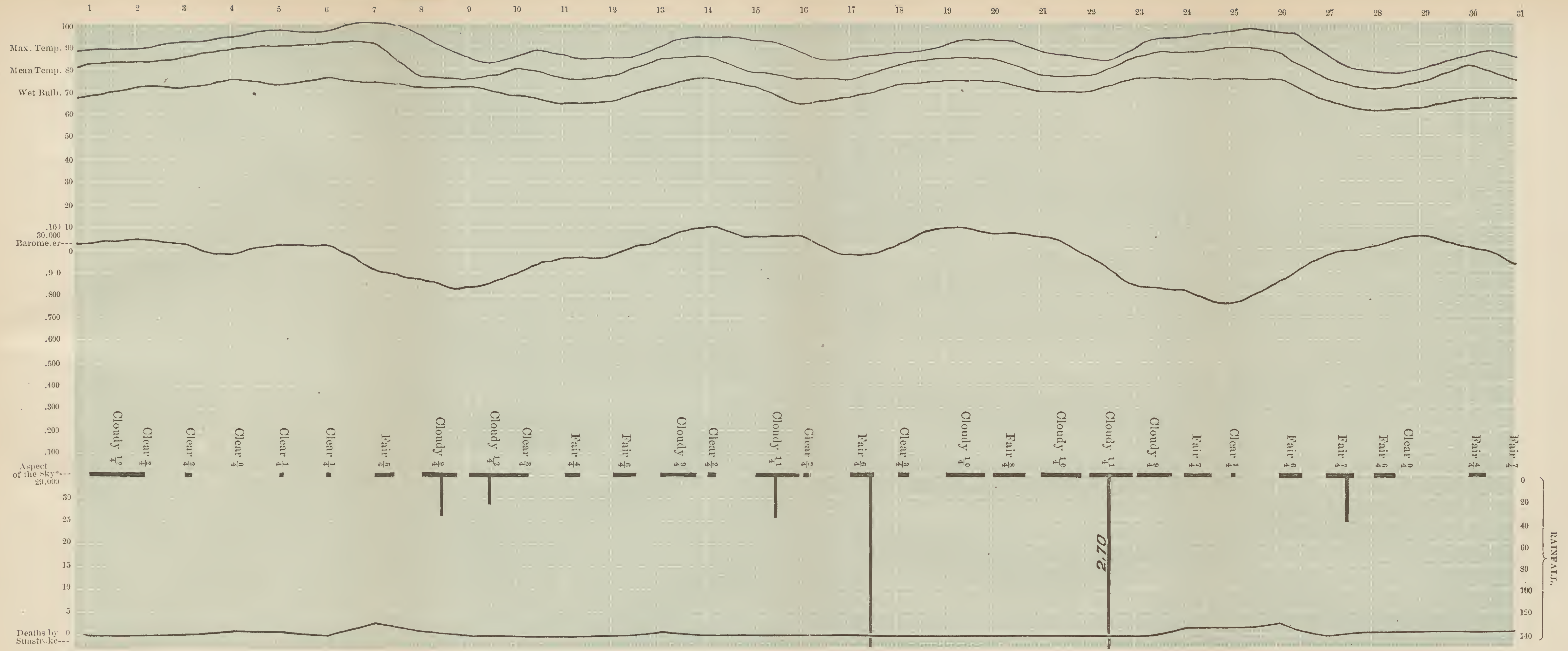
The chart for 1874 may be read as follows:

On July 1st, the mean temperature was 80°; the wet bulb, 68°; and a maximum temperature of 89° was attained; the day was entirely cloudy. On the 2d of July, the maximum temperature remained the same; while the mean temperature rose to 84°, and the humidity with it to 71°. The day was clear, showing only two-fourths cloudiness. (In the Signal Service, the clearness, fairness and cloudiness of the weather is estimated as follows: Observations are taken three times in the twenty-four hours, and the aspect of the sky, for both upper and lower clouds, noted in fourth parts of the whole sky at each observation. This gives twelve-fourths for record each day. If in from *none* to three fourths of all these observations within the twenty four hours, the sky has been covered, the day is noted as *clear*. If in from four to eight-fourths inclusive, the day is *fair*, and if in from nine-fourths to twelve-fourths inclusive, the day is noted as *cloudy*).

The fourth of July was a perfectly clear day, and the mean temperature rose to 89°; the wet bulb to 75°; and the maximum temperature to 95°. There was one death by sunstroke. The two following days were also clear (one fourth cloudy each,) and the humidity rose by the 6th, to 76°; the mean temperature to 91°, and the maximum temperature to 98.5°. There was one death by sunstroke. As yet, there had been no rain since the beginning of the month. The maximum temperature continued to rise, reaching 101° on the 7th; the mean temperature standing stationary at 91°, while the humidity had fallen 1°. There were four deaths by sunstroke, the greatest number occurring on any one day in July.

On the 8th of July, there was quite a fall of rain (0.37 inches), and coincidently with this, or as the cause of it, a fall in maxi-

PLATE IV.



A CHART SHOWING THE METEOROLOGY OF THE MONTH OF JULY, 1874, IN THE CITY OF ST. LOUIS, AND THE DAILY MORTALITY BY SUNSTROKE.

*The horizontal black spaces show the Cloudiness of the Sky in *Fourths*.

mum temperature of 6°; of mean temperature, of no less than 14°; and of humidity, of 4°, to 71°; there was but one death. On the following day, the temperatures continued to decline; the maximum temperature falling to 82°; the mean temperature to 76°; while as a consequence of the rainfall of the day before, the humidity rose 1°. As a result of this rapid diminution of temperature, the deaths by sunstroke suddenly ceased.

On the 13th of July, we note one death by sunstroke, the day being cloudy; the maximum temperature having abruptly risen within the previous forty-eight hours, from 84° to 89°; the mean temperature from 76° to 84°; a very sudden and unusual movement, while the humidity had risen from 65° on July 11th, to 71°. The humidity and mean temperature continuing to increase, both attained the height they had previously reached, but the maximum temperature failed to reach its grade of the 7th of July, by no less than 7°. The tendency thus begotten towards sunstroke on the 13th and 14th, was almost simultaneously nullified by an immediate descent of both temperatures with the humidity, the latter through a decrement of 12°. The next day was cloudy and cool, with a fall of rain of 0.36 inches.

Up to the 22d of July, there are no cases of sunstroke recorded; the sky was mostly overcast, with heavy rain (1.50 inches) on the 17th. The maximum temperature had not surpassed 93°; and this only on two days; the mean temperature had touched 85° but once (on the 19th), and the humidity had not risen above 75°; promptly declining again to 70° (on the 21st).

About this date, another march of the meteorological conditions, inductive of sunstroke, begins. On the 22d, the maximum temperature reached 84°; the mean temperature, 76°; and the humidity, 70°, as on the day before. On this day there was a very heavy fall of rain (2.70 inches), and in twenty-four hours the humidity had risen to 76°. The temperatures also rose suddenly; the mean temperature, through 10°, to 86°; and the maximum temperature, to 88°. This was obviously an exceedingly hot twenty-four hours, as the slight excess of the maximum temperature, (only 2.0°) over the mean temperature sufficiently shows. No more rain fell again for five days, the clouds rolled away in great part, and the temperature rose and was maintained at a very unusual height.

On the 24th the sky was fair, the heat continued to increase, the mean temperature rising to 87.5°; and the maximum temper-

ature to 96°; the humidity remained stationary at 76°. There were two deaths by sunstroke.

On the 25th, the humidity remaining unchanged, the aspect of the sky being still more open (clear; but one-fourth cloudy); the temperature rose still higher, viz., the mean temperature to 90°, and the maximum temperature to 99°. Two deaths by sunstroke are noted for that day.

On the 26th, the cloudiness of the sky was increased to six-fourths, and the humidity and both temperatures began to decline; there were three deaths by sunstroke; but on the following day, not one.

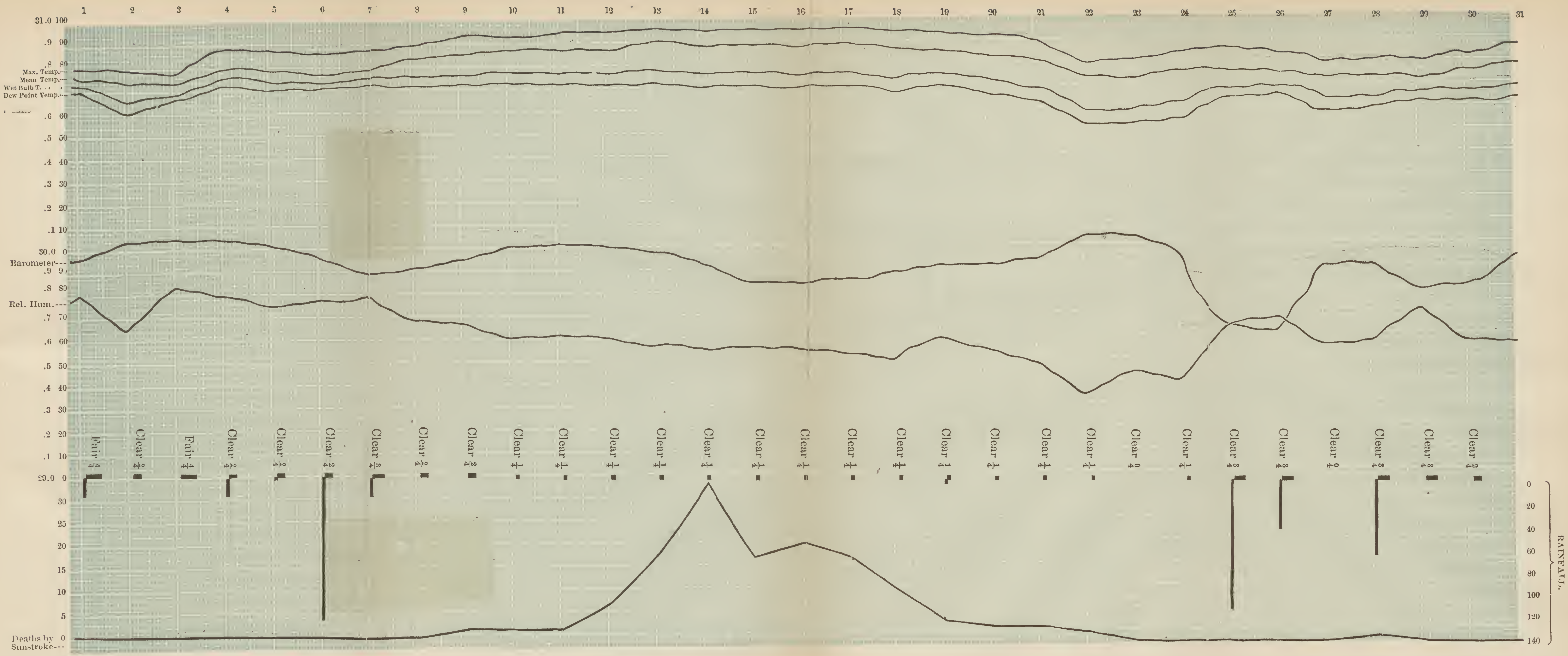
Between the 26th and 28th of the month, the maximum temperature fell through 20°, from 99° to 79°; the mean temperature, from 88° to 71°; and the humidity, from 76° to 61°; with a fall of rain of 0.40 inches. There was one death by sunstroke on the 28th, one on the 29th, and one on the 30th; cases which had probably lingered for a few days after being fatally affected between the 23d and 26th.

In the month of July, 1874, we thus find two periods of sunstroke—the first ranging from the 4th to the 7th, and the second from the 23d to the 26th, embracing three days each. In each case, soon after the effects of the meteorological conditions began to appear, they were neutralized by a sudden declension of the heat and humidity, with cloudiness and smart rain. As compared with each other, we find that in the first the humidity oscillated about 75°, and in the second stood steady at 76°. The maximum temperature attained in the second period was not so high by 2.0° as in the first, though well sustained in both. In the second period the mean temperature was distinctly lower than in the first, in which latter, moreover, it was nearly steady at the extraordinary figure of 90° or 91° for the three days. *In both periods* we note a *clearness of the sky* belonging to *no other part of the month*, which was generally cloudy, viz., 172 fourths of a possible 371, or 46.36 per cent of cloudiness.

Let us now examine the year 1878 in the same way.

The mean temperature of the whole month of July, 1878, was 82.31°; the highest for five years, the next highest being that for July, 1874, which was 81.22°. The mean humidity for the month was 72.69°, also the highest in five years, that for 1874 being 70.25°, a little more than one degree below its mean. The total cloudiness of July, 1878, was 51 fourths of a possible 371, or 11 per cent

PLATE V.



A CHART SHOWING THE METEOROLOGY OF THE MONTH OF JULY, 1878, IN THE CITY OF ST. LOUIS, AND THE DAILY MORTALITY BY SUNSTROKE.

*The horizontal black spaces show the Cloudiness of the Sky in *Fourths*.

of cloudiness only; the month, consequently, was greatly hotter, far more humid, and less than one-fourth as cloudy as July, 1874. There was but one maximum of deaths by sunstroke instead of two, as in 1874, and the meteorological conditions likewise present but one general maximum, which, however, continued for eleven consecutive days, with only trifling oscillations. The total rainfall was 3.93 inches, against 5.86 inches in 1874, the mean for five years being 5.65 inches. No rain at all fell during the epidemic of sunstroke, but a a heavy fall of 1.25 inches three days before it began, and another of 1.15 inches two days after it ceased.

The chart is to be interpreted as follows: On the 1st of July the temperature and humidity fell, the maximum temperature from 79° to 72°, the mean temperature from 73° to 71°, and the humidity from 70° to 63°. From these points they now began to rise, the temperature never again falling so low during the month, and the humidity reaching 63° again only after a lapse of twenty which *included the whole period* of the sunstroke epidemic.

It was on the 2d of the month that the temperature and humidity began their almost uninterrupted rise. On the 4th the maximum temperature stood at 87°, the mean temperature at 78° (mean of five years 79.78°), or 1.8° below its mean, and the humidity at 73°, (mean of five years 71.27°) or 1.73° above its mean. On the same day, which was clear, there was a smart fall of rain, 0.26 inches. On the 5th the maximum temperature had declined to 86°, the mean temperature to 77°, and the humidity to 72°, each by one degree. Comparing this with 1874, we have the following:

	Max. Temp.	Mean Temp.	Humid.
1878—July 5th..................................	86°	77°	72°
1874—July 4th..................................	95°	89°	75°

On the 4th of July, 1874, there was one death by sunstroke; up to the 5th of the month in 1878 there was no death by sunstroke, for although the rise of heat and temperature was sudden, it had not yet reached a sufficiently high grade.

On the 5th of July, 1878, in connection with the slight decline of another degree in the temperatures, there was a very heavy fall of rain, 1.25 inches; the weather was nevertheless clear, so that this must have been the result of a passing cloud. On the following day a light shower of rain also fell (0.16), being the last until the 25th of the month. The day (7th) being clear, notwith-

standing the shower, the temperatures continued to rise, and the humidity likewise, the sky being clear every day until the 9th, when the maximum temperature was 93°, the mean temperature 85°, and the humidity 76°; on this day there were no deaths by sunstroke. Comparing this day with July 4th, 1874, we have the following:

	Max. Tem.	Mean Temp.	Mean Wet B.
1878—First cases of sunstroke July 9.	93°	85°	76°
1874—First case of sunstroke July 4.	95°	89°	75°

The similarity of the figures is remarkable—expressing, probably, the lowest limitations of sunstroke for the City of St. Louis.

On the 10th we also have two cases of sunstroke, the temperature and humidity having risen from one to two degrees.

On the 11th the figures for the mean temperature and humidity are unchanged, while that for the maximum temperature has advanced one degree. The days are becoming still clearer; there were again two deaths by sunstroke.

On the 12th eight deaths by sunstroke are noted. The maximum temperature of this day was 96°, the mean temperature 89°, and the humidity 78°. The temperatures for the inception of the epidemic, as has been seen for 1874, had now been reached, and the humidity was already higher. With a still further advance in the next twenty-four hours of *the maximum temperature to 97°, of the mean temperature to 91°, and the humidiy to 79°*; the fatal season was fairly opened. On that day, the 13th, there were nineteen deaths by sunstroke.

By the following day, the 14th, the maximum temperature had declined 1°, to 96°; the mean temperature 2.0°, to 89°; and the huminity also 2.0°, to 77°. On this day, which was Sunday, thirty-four deaths occurred, the maximum of the season.

On the 15th we note a return of the maximum temperature to 97°, of the mean temperature to 90°, and of the humidity to 78°. Coincidently with this we note a sudden fall in the barometer to 29.864. On this day there were eighteen deaths.

On the following day, the mean temperature and humidity having fallen but one degree, the number of deaths remained about the same, viz., twenty-one. The maximum temperature had not varied.

On the 17th, the humidity had risen slightly (one degree), the mean temperature two degrees, standing for the second time only in the season at the terrible height of 92°, and the maximum

temperature attained 98.5°, the highest point reached in 1878, and yet 2.5° lower than that of July 7th, 1874. On this day there were also eighteen deaths.

From this date there is a plain, though at first gradual, decline of the meteorological conditions. On the 18th the maximum temperature had fallen to 97°, the mean temperature to 89°, and the humidity to 76°; we consequently note a decline in the number of deaths to eleven.

On the 19th the maximum temperature had still further declined to 96°, the mean temperature to 88°, while the humidity had risen by two degrees, to 78; we note a still further decline of the death rate to 4.

On the 20th the maximum temperature had fallen to 95°, the mean temperature to 86°, and the humidity to 75°; the number of deaths was three (*sunstroke plateau*). There was now a marked descent of the maximum temperature through 2.0° to 93°, of the mean temperature through 2.0° to 84°, and of the humidity through 3.0° to 72°. The number of deaths at once fell off to three, and the epidemic was practically at an end.

By the 22d the maximum temperature had fallen to 83°, the mean temperature to 77°, and the humidity to 62°, the lowest point reached (as a daily mean) for the month. The mortality was but two, the last of the epidemic.

On the 23d the maximum temperature had risen one degree, the humidity likewise one degree, while the mean temperature had still further *declined* one degree.

Thus far the skies had been almost cloudless, and there had been no rain since the 7th of the month, but on the 25th we note a heavy fall of rain (1.15 inches) and observe on the same day, which, notwithstanding the record of rain, is but three-fourths cloudy, a maximum temperature of 90°, a mean temperature of 80°, and a wet-bulb temperature of 72°. Up to the end of the month, the temperatures and humidity slightly declined from the grade last noted, [on the 27th,] to rise, however, again by the 31st. On that day we note a maximum temperature of 91°, a mean temperature of 84°, and a wet bulb temperature of 74°. The weather was still clear, 0.65 inches rain, a smart shower, fell on the 29th, but the day was, nevertheless, only three-fourths cloudy.

One death is noted by sunstroke on July 28th, and one also on August 1st. These may be neglected and were no doubt the delayed results of cases affected ten days or two weeks before.

I beg leave now to offer the following conclusions with reference to the etiology of sunstroke, fairly based upon the results of the foregoing statistical studies.

1st. Sunstroke has a period of incubation of from four days to a week. This is obvious from an inspection of the meteorology of the days preceding those on which the first deaths occurred, both in 1874 and in 1878.

2d. Sunstroke is not directly associated with the maximum temperature, for the maximum temperature was reached in 1878 three days after the maximum of deaths, and although the number of deaths in 1878 was nine times as great, upon the most fatal day, as in 1874, and five times as great for the entire season, which, in 1878, embraced only a period of 14 days, against a period of 56 days in 1874, nevertheless the maximum temperature of July, 1878, *was never so high as in July, 1874, by three or four degrees.*

3d. The condition of the inception of sunstroke are a notable fall of rain, immediately followed by clear days, with a rapid rise of the *mean temperature* to 88° or 89°, and of the mean humidity to 75° or 76°, in the city of St. Louis. This may be called *"the sunstroke plateau."*

4th. The conditions of maintenance and exacerbation of an epidemic of sunstroke, are a maintenance of the above grades of mean temperature and humidity, associated with an *unobscured sky*, viz., clearness of the days, or an exaltation of these conditions.

5th. As soon as the mean temperature and humidity begin to decline, the number of deaths decreases, although the effect of the previous heat and moisture is carried over for several days so as to cause death even while the meteorological conditions are on the decline.

6th. It is highly probable that the grade of heat and moisture requisite to cause sunstroke bears a certain relation to the mean annual temperature and humidity, and so varies for different cities.

7th. No relation is observable between the line of relative humidity and the mortality by sunstroke. For reasons already stated, this must be the case, for as the humidity thus expressed

is only relative, the figures or line indicating it will often decline, when the dew point or temperature of evaporation with the *absolute* humidity, has really risen, and *vice versa*. For this and other reasons already set forth, this mode of noting the humidity is not available for any kind of epidemiological research, and inattention to this quality of the records of the relative humidity has doubtless led some writers to imagine that the humidity, which is really one of the most potent factors in the production of sunstroke, or as the affection should be more accurately called, heatstroke, is without influence in inducing this affection. Had the dew point, absolute humidity, or the temperature of evaporation (wet bulb temperature) been examined, instead of this heterologous figure, the conclusions reached would have been different.

The influence of continued high mean temperature in producing sunstroke is illustrated in the occurrence of the affection in those who have not been submitted to the direct heat of the sun. A high mean temperature signifies hot nights as well as days, and an unremitted assault of heat upon the economy. If this constant overheating be not alone adequate to precipitate an attack, it constitutes the most powerful predisposition thereto, so that undue exercise, excitement, or indulgence in alcoholic drinks, or exposure to the sun, will, in such cases, promptly prove direct exciting causes.

Much, no doubt, depends upon the facility with which the system reacts against the influence of unusual heat. The principal of these mechanisms of self-protection with which the economy is endowed, is perspiration and the attendant refrigeration of the body due to evaporation of the sweat. Hence, when the system responds readily by sweating, the body is necessarily cooled, or its temperature restrained in a degree directly related to the amount of humidity of the air. It seems, however, that this faculty of pouring out sweat when the body is overheated, is not so fully possessed by persons of all latitudes, nor by the same persons at different periods of the year. By the gradual increase of heat, proper to a regularly advancing season, this responsiveness of the system is re-awakened anew each year and gradually, week by week, as the weather grows warmer, rendered more easy and prompt. But when, after cool weather, a rapid rise of temperature occurs, the economy appears to be taken at unawares, and by reason of the general disturbances

of the system, wrought within a few days by the constantly mounting temperature, becomes either wholly unable to respond, or fails to do so as completely as it would no doubt do, somewhat later in the season. The system being thus overheated, a general nervous discharge sooner or later occurs, which leaves the patient in a state of profound shock. Sunstroke is essentially a condition of shock, most probably identical with that caused by a stroke of lightning, though this is devoid of prodromes, and should be treated as shock, with due attention, however, to a prompt, though very careful reduction of the temperature to a point never lower *at least*, for the entire body or any part of it, than what is normal. The condition of the skin, liver, and kidneys, involved in the derangements which constitute the *predisposition* to sunstroke will require special treatment, as well as the tendencies to visceral congestion and subsequent inflammation, so well known as the formidable sequelæ of an attack.

PART II.

CHOLERA SPORADICA.

The designation "cholera," in the St. Louis records, signifies deaths by "cholera morbus" and "sporadic cholera." That these two terms are synonymous, there can be but little doubt; and the record has been placed in the tables under an implied assumption that "cholera morbus," "cholera sporadica," and "cholera asphyxia," or "asiatica," are affections differing from each other mainly in an etiological point of view, subject to the same meteorological laws, and evolved by closely similar terrene conditions. The epidemic form of cholera, in my opinion, bears the same relation to sporadic cholera, including "cholera morbus," that epidemic yellow fever does to sporadic or isolated cases of the same disease, or to those cases of malignant fever with or without black vomit, which are seen before the outbreak of epidemics of yellow fever, or are scattered through the season. With regard to the denomination of such cases from a *theoretical standpoint*, there has been always much dispute, under the influence of bias induced by a desire to protect the commercial interests or the sanitary reputation of the city where they occur; while, from a purely *clinical point of view*, they can only be ranked as true cases of the disease, not yet epidemic, or not to become so in that special season or locality, mainly on account of the absence of appropriate meteorological influences.

Cholera sporadica is undoubtedly induced by the ingestion of improper food or drink, but is manifested only when a certain predisposition exists; and it is by this predisposition, briefly, that the disease is linked, as a minor term, to the general "epidemic" expression known as "cholera asphyxia." The epidemicity of cholera is, I think, merely the result of the intensification of the sporadic disease, and is implied by the term "malignant." That malignant cases of sporadic cholera, including "cholera morbus," are *inherently* contagious, is very probable; and that cases occurring in the presence of previous ones are so, either by emanations from the body or from the discharges, cannot be doubted.

The consideration of cholera, in the record of St. Louis, was intended for comparison in these points with the same designation, for the past five years, in the eleven cities. I have not, however, been able to obtain the detailed necrology of these cities, although applying for it. And this remark relates also to another necrological group, viz., that of "malarial fever," so that, for both of these records, our study is unfortunately restricted almost entirely to the city of St. Louis, in 1878, and for the four years previous. That a comparison of these figures with similar ones for the other cities would have been highly profitable, I have good reasons to believe.

The following table shows the prevalence of sporadic cholera in St. Louis, during the last five years:

YEAR.	July.	August.	September.	October.	Summary.
1878.	3.3	0.4	2.0	....	5.7
1877.	5.4	2.6	....	....	8 0
1876.	5.4	1.0	1.0	....	7.4
1875.	7.0	2.4	2.6	1.0	13.0
1874.	18.6	8.4	....	....	27.0
Mean	7.93	2.97	1.12	0.20	12 2

The deaths are expressed in integers and fractions. These fractions arise in consequence of the fact that the records have been drawn from returns made by weeks, so that, in order to reduce these weekly figures to those for the number of days proper to each month, calculations have been required in which fractions have necessarily resulted. This remark applies to many of the mortuary, as well as the meteorological figures, which I have gladly accepted in the form in which they were presented to me, for a total rearrangement of such a multitude of figures would have been quite impracticable, and, indeed, was in no sense necessary. All calculations of this kind have been made with the most scrupulous care, and they have constituted a very large portion of my labor.

It will be observed from the table that the maximum of deaths by "cholera" occurs in every year in *July*, and that the mortality rapidly declines in August, becoming still smaller in September, with a disposition to disappear in October. This movement is clearly expressed in the means at the bottom of the table.

Subjoined is a comparison of these *means*, with the mean temperature, mean humidity, rainfall and number of thunderstorms for this city:

	July.	August.	September.	October.
Mean temperature........	79.92	76 87	69.60	55.78
Wet bulb.......	71.27	68.02	61.35	49 84
Rainfall (inches)...............	5.58	3.97	3.46	2.41
Number of thunderstorms	2.45	2.40	0.97	0.80
Deaths by Cholera	7.93	2.97	1.12	0.20

The simultaneous declension of all these figures from month to month will be noted. Cholera is the associate of the highest temperature, the highest humidity, the greatest rainfall, and the month most subject to thunderstorms. Even a small declension of the grade of the meteorological elements, in September, indicates a falling off of the death rate, by cholera, by more than 62 per cent. The absolute maximum of deaths occurred in July, 1874, viz., 18.6; and we have already observed that the alternations of temperature and humidity were greater in this month than in any other July of the five years. On the contrary, the minimum occurred in July, 1878, in which the temperature and humidity were least subject to fluctuation. It may be allowable to conclude, therefore, that extensive and sudden oscillations of temperature and humidity about a high standard are intimately associated with this affection.

Below I present a comparison of the death rates by cholera and by malarial fevers, the figures being the means of all the years:

DEATHS BY	July.	August.	Sept.	Oct.
Malarial Fever........................	20.42	27.96	52.43	38.75
Cholera..................................	7.93	2.97	1.12	0.20

It will be observed that the figures move in an inverse order, the mortality by "malarial diseases generally" steadily increasing to September and then declining, while that for "cholera" rapidly declines throughout the season. A closer scrutiny of the figures evolves this relation of incompatibility still more exactly. Thus, comparing the different years with each other, and arranging the deaths by malarial diseases in incremental order, we have the following:

YEAR.	1878	1877	1876	1875	1874	Totals.
Malarial Diseases	197.49	157.9	148.1	138.83	55.6	642.23
Cholera	5.7	7.4	8.0	13.0	27.0	61.1

It will be seen that the maximum of deaths by malarial diseases coincides with the minimum of cholera, both occurring in 1878, while the minimum of deaths by malarial diseases coincides with the maximum by cholera, and likewise both in the same year, 1874, while in 1875 we have figures very near the calculated mean for the five years, thus: Calculated mean for malarial diseases, 139.56; actual number of deaths by malarial diseases in 1875, 138.83; calculated mean for cholera, 12.42, and actual deaths in 1875 by cholera, 13.0. Both the extremes and means behave with complete regularity, as they should do, under the hypothesis of antagonism, which must consequently be accepted as a fact.

This antagonism between cholera sporadica and malarial fevers is wholly similar to that which exists between epidemic cholera and yellow fever. Epidemic cholera is a disease of lower humidity than yellow fever, and affects the early summer months, giving place to yellow fever in August, September and October. In this latter month, however, it begins to reappear, and becomes prevalent again as soon as the yellow fever declines. This mutual replacement is notably illustrated in the *successive* epidemics of cholera and yellow fever in Memphis, in 1873; in the prevalence of cholera in Charleston, in 1836, to the exclusion of yellow fever, and in the abolition of cholera in New Orleans during yellow fever epidemics.

PART III.

"MALARIAL FEVERS," AND "FEVERS GENERALLY" IN RELATION TO YELLOW FEVER.

The following assigned causes of death as reported at the Health Office, have been counted as falling properly within this class, viz: bilious-remittent, intermittent, typho-malarial, congestive, continued, malarial, malignant and pernicious fevers; general congestion, and congestive chill. I have made the analysis in person, and the figures, as in the case of yellow fever and sunstroke, may not be exactly those published by the Health Office, as my own interpretation of the causes of death, may in a few instances vary from that of the Health Office. For all but two years of the five, this action on my part was imperative, as no weekly or other printed classification exists, while for 1877 and 1878 I have strictly followed the official lists, except for two weeks in 1877, which have been lost, and had to be made up in consequence directly from the *Journal of Record.*

The following table will show the mortality by malarial diseases for the city of St. Louis, for the past five years with the seasonal totals and monthly means:

	July.	August.	Sept.	October.	Totals.
1878	45.72	45.82	68.13	37.73	197.40
1877	23.60	33.10	50.00	41.40	148.10
1876	11.70	18.70	69.71	38.72	138.83
1875	8.40	25.60	58.50	65.40	157.90
1874	12.70	16.60	15.80	10.50	55.60
Means.	20.42	27.96	52.43	38.75	139.55

The greatest mortality is in September, the least in July; the least number of deaths for any season was in 1874, the greatest in 1878. In 1878, the mortality was 197.40, an excess of 41 per cent above the average of the five years. These figures, therefore, establishes the correctness of the opinions expressed by the majority of the medical men interviewed with regard to the prevalence of malarial diseases in St. Louis in 1878. This year was greatly more fatal by this class of diseases, than any other for

five years past. The mortality is seen to have been excessive in July, to have continued at the same rate in August, reaching its highest figure in September, and declining in October, in which month alone of the season, it descended to the proper mean of the month. The unusual mortality consequently occurred in the first three months of the season. The influence of heat in July upon this mortality, is shown by the following table. The temperature is incremental:

Year.	Temp., July.	Mortality.	Year.	Temp., Aug.	Mortality.
1878	82.31°	45.72	1878	79.17°	45.82
1874	81.5	12.70	1874	78.2	16.60
1876	79.2	11.70	1876	77.8	18.70
1877	78·4	23.60	1877	76.0	33.10
1875	78.2	8.40	1875	73.1	25.60

In July, 1878, we find the highest temperature coinciding with the highest rate of mortality for that month, and in July, 1875, we find the lowest rate of mortality coinciding with the lowest temperature for that month; while to show that there is a real relation between the figures, and that this is no mere accident, we find that the sum of the two figures of mortality next to the bottom of the table, 32.00; while that of the two mortality figures at the top is 58.42; the middle figure being neglected. There is a strict and inherent variation in the mortality figures in the direction of the temperature. In the table for August, the maximum temperature coincides with the maximum mortality; the minimum mortality, however, does not coincide with the maximum temperature; nevertheless, if we neglect the middle mortality figure, we find that the sum of the two mortality figures towards the top of the table, is equal to 62.42; while that for the two figures nearest the bottom, is 58.70; which again shows, that in August likewise, there is a direct dependence of the mortality by malarial fevers upon the temperature. For the months of September and October, this can not be demonstrated from the mean temperature, 68.99, and 57.79 respectively; which are too low for the direct generation of such maladies; the deaths reported, being probably mostly those of protracted cases, or of imported ones. It must be concluded that the augmented mortality of September, is determined by other causes of special potency, acting in concurrence with an average temperature.

A relationship between the mortality by malarial diseases and the *humidity* can be observed for the month of July, the wet bulb temperature being arranged incrementally, thus:

YEAR.	Wet Bulb Temperature.	Mortality by Malarial Diseases.
1878.	72.69	45.72
1875.	72.24	8.40
1876.	71.85	11.70
1874.	70.25	12.70
1877.	69.32	23 60

The maximum mortality is observed to coincide with the maximum humidity, but the minima do not coincide; nevertheless, the sum of the two uppermost mortality figures, viz., 54.12, is considerably in excess of that of the two lowest ones, 36.30. No such coincidence of extremes, nor movement of the sum or or means, is to be observed for August or September. It is only in the first month of the season, that any influence of the humidity is traceable in this way, while we have found that such an influence is obvious, both in July and August, for the *temperature*. It may be logical to conclude, that in *St. Louis*, high heat is more distinctly associated with the origin of malarial disease than humidity. Other potent factors in the generation of these diseases are not determined meteorologically; such as the calmness of the nights, the degree of inguination of the air by the volatile and even concrete products of vegetable putrefaction, and the absence of ozone. This is approximately indicated by the frequency of thunderstorms. On examination of the table of means and totals for St. Louis, it will be seen that thunderstorms rapidly diminish in frequency after August, the figures being as follows: Common mean of five years for July, 2.45; for August, 2.40; for September, 0.97; for October, 0.80. Malarial diseases we have seen to be most frequent in September, in which month, *there is not one thunderstorm* on an average; continuing in October, which is still less subject to thunderstorms than September, until checked by the encroachment of cold weather.

It will be noticed finally, that the deaths by yellow fever, interpolated into the table for the year 1878, as "indigenous cases," began in the last week in August, continuing in a scattering way through September, reaching their maximum in the third and fourth weeks of October, and being finally arrested by the declension of the mean temperature in the first week of November.

Yellow fever of indigenous origin only appeared in St. Louis and its suburbs, in that month, viz., September, in which the common

average of mortality by malarial diseases, reaches its maximum, and in which also, in the same year, viz., 1878, the absolute maximum of that particular year was attained. Its acceptance, therefore, seems logically to be associated with the highest intensification,—most probably by cumulative influences operative upon and within the economy, of the same general conditions which underlie the exaltation of the figures for the malarial mortality.

It seems reasonable, in other words, to assume in conformity with numerous considerations of a general character, that the susceptibility to yellow fever, clearly evinced in thirty-one cases in the city of St. Louis, in 1878, was founded in the great majority of cases, in those changes of nutrition which are induced by the meteorological and telluric conditions, commonly effective in the production of various forms of malarial disease.

I greatly regret that it has proved quite impracticable for me to obtain, either by personal application, or under the auspices of the St. Louis Medical Society, a systematic record of the prevalence of malarial and other fevers from the cities, excepting St. Louis, whose meteorology is in my possession. The difficulty has been in a lack of clerical force in the municipal health offices. I can only, therefore, append some considerations bearing upon the interesting point of the relation of yellow fever to malarial fevers, and to fevers generally, extracted from documents which have come into my hands in the correspondence relating to this subject.

From the annual report of the Board of Health of the City of New Orleans to the General Assembly of Louisiana, I quote the following table bearing upon this interesting subject,—showing the number of deaths in New Orleans (Population by census of 1870, 191,418) by the several febrile diseases,—for the six years 1867–1872 inclusive both ways.

	1867.	1868.	1869.	1870.	1871.	1872.
Fever, Bilious	45	29	12	35	25	22
Fever, Congestive	533	207	228	241	163	165
Fever, Intermittent	51	30	32	27	26	27
Fever, Remittent	110	36	36	51	39	26
Fever, Typhoid and Nervous	132	85	68	84	73	68
Fever, Typhus	23	5	5	13	4	4
All fevers	894	392	381	451	330	312
Yellow fever	3107	3	3	587	54	39

It will be observed that there are two maxima for yellow fever in the series of years, or what we may term a maximum and a sub-maximum. The maximum for yellow fever

was in 1867, the sub-maximum, in 1870. We also find that the maximum for "bilious fever occurred in 1867, and its sub-maximum in 1870. For "congestive fever" the maximum was again in 1867, and the sub-maximum as before in 1870. The maximum for "intermittent fever" was in 1867, the sub-maximum in 1869. For "remittent fever" the maximum is in 1867, the sub-maximum in 1870.

For "typhoid" and "nervous" fever (I have united the two figures, as they plainly designate "enteric fever;") the maximum is found in 1867 and about equal figures, viz., 85 and 84, are found in 1868 and 1870 respectively. For "typhus fever" the maximum is in 1867, and the sub-maximum in 1870.

Taking the sum of each of these fevers, as "all fevers," we find that the maximum occurs in 1867 and the sub maximum in 1870.

This very important result may be expressed as follows:

In the group of six years from 1867 to 1872, inclusively, we find that yellow fever prevailed in an epidemic form of marked intensity twice, viz., in 1867 and in 1870, the mortality being greatest in the former year, and next greatest in the latter. And on examining the mortality by coexisting fevers, we note that the maximum of deaths in every form of fever occurred in 1867 coincidently with the maximum mortality by yellow fever; and still further, that the *next highest* mortality by each of the fevers noted, occurred in that year, viz., 1870, in which there was the *next highest* mortality by yellow fever, in every case except "intermittent fever" and "typhoid and nervous fever;" in the first of these, the figures being nearly equal for the last five years of the series, and for the latter the figure being within one of the sub-maximum.

New Orleans is the only city of the Union subject to periodical visitations of yellow fever, sufficiently populous to afford mortality figures by undisputed endemic fevers great enough to eliminate irrelevant perturbing influences.

The parellelism shown in the table is indisputable—extending not merely to the maxima, but even to the sub-maxima—and warranting the following conclusions:

1st. In New Orleans the greatest mortality by yellow fever coincides with the greatest mortality by each of the endemic fevers and by "all fevers."

2d. There is the plainest indication of a tendency of each and all of the endemic fevers to move in parallelism with yellow fever.

3d. COROLLARY.—This parallelism shows that the fundamental causes and conditions of yellow fever, and of each and all of the endemic fevers, *are the same;* and as it is denied by no one that the conditions of bilious, congestive, intermittent, remittent, typhoid and nervous, and typhus fevers, are local, while the two latter forms are universally admitted to be contagious; so, therefore, *it ought not to be denied* that the conditions of yellow fever *are local*, yellow fever being admitted to be contagious by everybody who has had fair opportunities of studying the disease where it prevails frequently.

In the same report (New Orleans, 1872), I find the following interesting confirmation of the indications of the table above given: An elaborate chart is published with this report, showing the total mortality and chief fatal diseases for the City of New Orleans for the last six months of the year 1872. In this chart we find that the line indicating the number of deaths by yellow fever reaches its maximum on the 26th day of October, and the line for "all fevers" reaches its maximum the *next day*, viz., the 27th of October! Both lines thence rapidly decline in almost exact parallelism to the end of the season.

From a table of mortality for the year 1853, in New Orleans, we extract the following (Barton's Report, p 250 :)

1853.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total for the Year.
Yellow fever........	31	1521	5133	982	147	28	4	7849
Malignant fever......	12	6	....	....	....	....	....	34
Pernicious fever.....	....	18	54	52	16	....	3	152
Congestive fever.....	11	19	25	9	0	2	0	77
Remittent fever......	7	9	5	3	1	1	0	29
Intermittent fever....	2	6	10	1	1	2	2	38
Bilious fever	5	7	2	0	3	1	0	21
Typhus fever.........	9	19	13	0	3	4	7	103
Typhoid fever........	9	10	21	24	7	8	13	146
Other fevers	9	5	17	3	5	1	3	69
All fevers ex. yel. fev	64	99	147	92	36	19	28	669

We perceive that in the *month* in which the greatest mortality by yellow fever occurred in that fearful year, there was likewise the greatest mortality by "pernicious fever," by "congestive fevers," by "intermittent fever," by "other fevers," and by "all fevers," viz., the month of August. The progression of the fig-

ures, especially for "all fevers," is in very strict parallelism with those for yellow fever.

The population of New Orleans in 1853 Barton gives as 154,182. By the census of 1870 the population was 191,418. Taking this figure as the mean of the six years already considered, we may estimate the number of deaths for all fevers excepting yellow fever at 824, which approaches that for the year 1867 (894), being like it, greatly in excess of a similar figure for any other year, while the mortality by yellow fever was also at its maximum.

We may conclude, therefore, that in yellow fever years and seasons, there is an unusual prevalence of all forms of fever; and further, that this prevalence of febrile diseases, generally and specially, varies directly as the prevalence of yellow fever itself. The prevalence of yellow fever is, therefore, subject to the laws which govern the appearance and prevalence of each and all other varieties of fever. All fevers, *including yellow fever*, are subject to fundamental causative and controlling agencies, which must be local in character, notwithstanding the admitted fact that many of these fevers, like yellow fever, are contagious beyond all controversy. The whole group of fevers is *directly antagonistic to cholera*. These two forms of disease are not compatible with each other. The year, the season, the month, and even the week in which the greatest absolute number of deaths by malarial fever and by fevers generally occurs, is likewise that year, season, month, or even week in which the greatest mortality by yellow fever will also occur, and *vice versa*, in cities at least subject to frequent outbreaks of yellow fever. In such cities I am confident the number of deaths from yellow fever or from fevers generally, may even be determined *approximately* by calculation, if we have the data either of yellow fever, or of fevers generally.

It would appear that in cities where yellow fever frequently occurs, malarial fevers, while widely prevalent, do not tend to pass into yellow fever, for the plain reason that the greater number of those attacked by such fevers are already acclimated against yellow fever. The malarial fever thus refuses to assume the garb of yellow fever, because the immunity previously acquired by long residence, or by having had yellow fever, still holds good even during an attack of malarial, typhus, typhoid or other form of fever. In individuals, on the other hand, who are

not exempt from yellow fever, each of these forms of fever tends to pass into yellow fever, and almost certainly does so in the presence of a great epidemic of this latter malady.

This consideration should, consequently, be especially active in cities where yellow fever but rarely appears, and where there is but little acclimation against the disease. In Vicksburg and Memphis this fact was well illustrated in 1878.

In Vicksburg, with a population of 12,500, there were 983 deaths by yellow fever in 1878, and but *one* death, so certified, by malarial fever. In Mobile there were thirty-three deaths by malarial fevers in 1877, and none by yellow fever; while in 1878 there were only *five* by malarial fever and sixty-four by yellow fever. In Memphis, with a population of 50,000, there were 2,709 deaths by yellow fever up to November 1st, and but *six* deaths, *so certified*, by malarial fevers, while there should have been 19.7 deaths by malarial fever, by calculation even from the figures of St. Louis—a greatly less malarial city than Memphis. In Louisville, there were seven deaths by malarial fever, and twenty-eight deaths by indigenous yellow fever, in 1878, while in 1877 there were sixteen deaths by malarial fever proper, and no yellow fever.

These low figures for 1878, so greatly lower than the annual mean of deaths by malarial fevers in Vicksburg, Mobile and Memphis, where yellow fever epidemics are rare, in connection with the unprecedented mortality by yellow fever in 1878, appears to warrant the conclusion that lack of acclimation against the latter malady was the cause at once of its fearful prevalence, and of the striking declension, amounting almost to an abolition of the figures for malarial fevers in cities moreover which are well known to be remarkably subject to malarial affections.

I greatly regret that I am unable, for lack of proper data, to present this important subject in a more probative form. Space, indeed, at present forbids my doing so, and I must leave a fuller elaboration of it to others.

PART IV.

YELLOW FEVER.

I think it may not be inappropriate, before engaging in our inquiries, to make a sort of confession of faith in advance, and statement of principles. In this way any misconception of my position on these subjects will be avoided, and the general drift of the meteorological studies about to follow, more easily perceived. At the same time, the reader will be better able, knowing my views beforehand, to judge in what degree I am justly authorized in holding the opinions to be presently expressed.

1st. Yellow fever is not a peculiar, or so-called specific type of fever but simply a malignant form of *typhus gravior.* It is contagious in varying degrees, according to the susceptibility of those exposed to it, in different years and cities, and very probably, most contagious when most malignant.

2d. Yellow fever is always *primarily* caused by the action of the effluvia of animal putrefaction upon the human body under cotemporary conditions of high atmospheric heat and humidity.

3d. When so originated, as it may be in any place whatsoever where the above mentioned conditions are present in adequate intensity and for a sufficient *length of time*, being contagious, the disease is readily transferred by implantation into localities already affected by meteorological conditions similar to those among which it made its appearance.

4th. Yellow fever is most readily contracted by contagion, when the temperature and humidity are high, but a *long exposure* to its contagion will equally effect a manifestation of the disease, when the temperature and humidity are not excessive, and even when they are below their mean, provided unusual susceptibility exists.

5th. Yellow fever is caused in the first instance, wherever it appears, by the emanations from putrefying animal matters, more especially the urine and fæces of man and animals, and is *propagated* by its own materies contagiosa.

6th. The cities of warm regions near the sea level are especially liable to yellow fever, and as they are in continual communication with each other by land or water, all such cities must be regarded as a single compound center of civilization, with necessary relations to each other, and constant transference of inhabitants. The cities of this group are quite analogous to the wards and suburbs of any single city, which exist under similar meteorological and terrene conditions, and are in frequent contact with each other. As yellow fever may arise in any ward of a city, and be disseminated through it, or implanted in different wards by contagion, similar and concurrent meteorological conditions being presupposed, so likewise it may arise in any city of the compound group of cities known to be subject to it, and be transferred to other cities of the group, provided meteorological conditions are present similar to those of the place where it originated. Thus yellow fever may originate in Havana, and be rapidly transferred to Charleston, Mobile or New Orleans, while in each of these three cities and in the same year, even, yellow fever of purely autochthonous origin may appear and be transferred to Pensacola, Norfolk, or even to localities of Havana itself where the disease had not as yet been seen. In other words, yellow fever is produced in some one or all of the cities in which we first see it, or has been transferred thither by contagion.

It is often very difficult and even impossible to say positively whether any given case or outbreak of yellow fever is due to local causes purely, that is, simply autochthonous, or to contagion brought from a neighboring city separated from the one in which the disease appears, by spaces which are easily traversed in a few days at most, and often in a few hours. Nevertheless the fundamental origin of yellow fever, in the submission of the human body at abnormally high and long continued degrees of heat and atmospheric humidity, to the influences of the effluvia of putrefaction, is to be unconditionally accepted, and no paradox whatever is implied in the assertion that a given case or outbreak may have been due, either to septic effluvia, *or* to the materies contagiosa. For although always autochthonous in the first instances, and in a great many cases, though by no means all, even in a city where we know it has been introduced, or more properly, *precipitated* from some other city, each local case becomes a focus, from which, in proportion to the facilites afforded

for communication, persons living in the immediate neighborhood, or at hundreds or even thousands of miles distant, may be directly affected.

In every season, therefore, nearly, yellow fever shows itself at some point of some one city of the general intercommunicating group of sea board and river cities ; perhaps at several points of more than one city, and every such point of autochthonous yellow fever, serves at once as a focus, from which every other part of the same city, or any or all of the other cities of the group *may* be affected.

While, therefore it is not possible to say in many cases, that a given case is or is not autochthonous or due to contagion, it is possible to affirm without qualification whatsoever, that every case of yellow fever is either in itself autochthonous, or lineally descended through one or more cases, from a case that was autochthonous.

A general conclusion may be expressed as follows: Yellow fever is caused by influences of the atmosphere and soil acting on the body, and is transferable from body to body through the intermediation of zymogenous, particulate, portions of the fluids and semi-solids of the economy, imbued with fermentative proclivities pervading the entire body whence they have been derived, the *proper contagious matter.*

7th. The fact that a second attack of yellow fever in the same subject is not a common one, (although I have seen three attacks in the same person) merely proves that at the time of the first attack, the system by its inherent power of reaction, was able to resist the disease successfully, and may, therefore, very reasonably be expected to do so ever afterwards more perfectly; so much so, as even to prevent the development of noteworthy fever, for it is a law under which we live, that successful reaction against disease implies, *ipso facto*, a strengthening and cultivation of the faculty of reaction. There is not, consequently, any necessity for assuming the *specificity* of the contagious element of yellow fever, for it is a fact, that by long residence or nativity in places where yellow fever often appears, an exemption, even more complete than that acquired by actual subjection to the disease, may be and usually is acquired. In such cases, the reactive power has been gradually and quietly exalted to the grade of intensity of the causes of yellow fever proper to the given

locality, but not sufficiently high for all places and conditions, for such exempts may contract the disease by exposure to very extraordinary meteorological conditions, in the presence of yellow fever, especially in conjunction with unusual fatigue. That the exemption from yellow fever due to acquisition of the disease or to so-called acclimation, is *not* comparable to the exemption from small-pox acquired by vaccination or inoculation, or similarly for measles and scarlet fever, is abundantly proved by the fact that this exemption from yellow fever is quickly lost, partially, or entirely, by mere absence from the locality to which the subject had become acclimated, or in other words, to whose usual conditions his economy had assimilated itself, the acclimation evidently consisting of a condition of the economy suggested by external influences, and maintained by the inherent reactive powers of the system, so long only, as the external assaults continued, but gravitating again towards a lower mean level of systemic balance, when by removal from the locality, such assaults are no longer made. Nothing of this kind occurs for small-pox, measles, or scarlet fever; an attack of either of these diseases, in the great majority of cases, protects its subject from the same disease, all over the world, after any period of exemption from contact with such diseases, and throughout life.

8th. Yellow fever is not, therefore, a specific self-protecting disease, but simply a disease of septicæmic character, primarily caused by the effluvia of animal putrefaction, and like all septicæmic diseases, more or less contagious. The materies morbi, or contagious particles, are exceedingly minute portions of the fluids of the economy, transudates or excretions, and consequently, when introduced into a second system, capable of determining a train of molecular movement, with induced reactive phenomena, precisely like those going on in the system whence they were derived. The act of contagion consists in the establishment in a second organism, by means of particles endowed with the definite zymogenous power belonging to every particle whatsoever of the economy which cast them forth, of a train of zymotic action wholly similar to that existing in the organism whence these particles were derived. The particles are yeast-like, and not living, nor capable of life, being derived originally from an organism whose integral parts and circulating fluids strongly tended towards putrefaction. Their qualities are not de-

stroyed by cold, but preserved by a low temperature, and are perhaps, like those of the vaccine virus, annulled by continued humid heat, their peculiar zymogenous disposition being thereby determined in the direction of common putrefaction, which is well known, as in carrying a vaccine scab in the pocket, or in the occurreuce of sloughing in soft chancre, to entirely destroy the peculiar properties of so-called specific viruses.

The object of the following analytical investigation is to show that yellow fever acknowledges as primary and indispensable to its existence, the conditions which are known to be primary and indispensable in the origination and maintenance of *putrefaction*, viz.:

a. Moisture, neither excessive nor deficient in quantity.
b. High heat of the earth's surface and of all things upon it.
c. High atmospheric humidity.
d. Stagnancy of the atmosphere.

By the term "yellow fever" I intend to imply what may be called "parent yellow fever," or the yellow fever of those foci, whence by contagion, under determinable conditions, individuals are affected by the disease at second hand, and epidemics caused and maintained.

The data in my possession for the purposes of this analysis are as follows:

1st. Published statements with regard to the appearance of yellow fever in 1878, as taken from various documents and from the public prints, and for years prior to this, from numerous articles which have appeared in current medical literature.

2d. The weekly meteorology of eleven cities of the United States for the four months of July, August, September and October of 1874, 1875, 1876, 1877 and 1878, furnished by the Chief Signal Officer from Washington, D. C.

3d. The necrological and meteorological reports for Charleston, S. C., for thirty-seven years, the series beginning in 1832 and extending to 1878, nine years of the series being unfortunately lacking, although their absence in no way affects the general indications of figures deduced from so long a series.

4th. Information in the way of documents or written answers to queries furnished from Health Offices, and by physicians resident in cities of the South and the Mississippi Valley, mostly.

These data, although by no means as compendious or systematic as I would have desired, will be found, I think, to be amply sufficient for the purposes to which they will be applied, and are indeed all that it has been possible for me to obtain after constant efforts of my own and of others who have interested themselves in the matter.

I now proceed to give a short statement of the principal facts connected with the outbreak of the yellow fever of 1878, in those cities whose meteorology is at my command.

RISE OF THE EPIDEMIC IN NEW ORLEANS.

From the "Conclusions of the Board of Experts" (Washington, January 29, 1879), I take the following:

First case of yellow fever, May 25th; first death, May 30th—an imported case. First case among the inhabitants, June 30th. An appended note states that the first certificate of death from yellow fever was on July 21st; several other deaths from June 30th to July 21st, believed to be yellow fever, but not so certified. That several cases of yellow fever, in widely separated parts of the city, had occurred before the end of the first week in July, I learn from Dr. D. W. Brickell, in a personal interview. In a letter dated July 24th, 1878, to Dr. J. M. Woodworth, Dr. Choppin states that "about the 12th of July cases of yellow fever began to appear in New Orleans, and up to the date of his letter, fourteen cases, with six deaths, had occurred." "It is clear," says Dr. Choppin in this letter officially announcing the outbreak of yellow fever in New Orleans, "that these cases did not result from the two cases that were developed two months ago on the Emily B. Souder immediately on her arrival from Havana." The Souder was engaged in regular trade between Havana and New Orleans, making her trips every two or three weeks. This was the vessel, it will be remembered, with which young O'Bannon, of St. Louis, came in contact while a cargo of sugar was being transferred from her hold to the main deck of the Commonwealth, on which O'Bannon was a clerk, on the 3d or 4th of July. O'Bannon came directly to St. Louis, and died on Friday, July 19th. His case must be regarded as one of these early New Orleans cases, in this instance, undoubtedly directly due to infection from Havana.

In his remarks before the American Public Health Association, at its meeting in Richmond, November 19th to 22d, 1879, Dr. Choppin stated "that the first cases of the epidemic of 1875 in New Orleans were undoubtedly two of the officers (the two cases alluded to in his letter of July 24th to Dr. Woodworth, above quoted, I think), of the Souder, viz., Clark, the purser, and Elliott, one of the engineers. Clark went ashore sick, "beating the Quarantine doctor," on May 23d, and died two days afterwards of yellow fever, on Claiborne street, near Conti. The burial certificate was given for "*malarial fever*." Elliott sickened after his arrival, and died on May 29th, no one suspecting the case to be yellow fever. His body was submitted by two competent physicians to a careful post mortem, and was inspected by the speaker. About the middle of July some cases of a strongly suspicious character came to light on Constance street, near its intersection with Terpsichore, and in a few days all doubt was removed of their true nature. About a week previously a young man named Cohn came to the Touro Infirmary from Gasquet street, between Marais and Villere, presenting strong appearances of yellow fever; but he recovered before attention was drawn to Constance street, and his case was considered questionable. Within a few days cases were found near the corner of Front and Girod streets, where Elliott had sickened; on Bienville, near where Clark had died on Claiborne street; and a case on Robertson street, near the home of Cohn, who had been at the Infirmary, not more than a quarter of a mile from where Clark died, and a still less distance from the Hotel Dieu, where Elliott died. The line of infection seems tolerably clear, though long latent, from Clark to Cohn, and subsequently to the cases on Bienville and Robertson streets; and also from Elliott, sick in his boarding-house, to the subsequent outbreak at the corner of Front and Girod streets; but the outbreak on Constance street was so far from the wharf of the *Souder* (fully half a mile), and so long after her arrival (more than six weeks), that it was long considered out of the question to establish a connection between them.

Recent investigations show that some of the earliest cases on Constance street, occurred in the family of a Mr. Coven, who is engineer of the tug boat, Charlie Wood. This boat lay at the same wharf occupied by the Souder, immediately after the departure of the latter for Havana, as stated by Coven himself at the time of his illness. Mrs. Wasson, Coven's mother-in-law, was sick in

the beginning of July, with symptoms answering closely to those of yellow fever, and two weeks later other members of the family, named Bolton, developed the same disease; and it has been ascertained that a colored laundress, Emma Watts, living in the yard of the Bolton family, had there done washing for Mrs. Wasson, and hung up her clothes to dry in the yard of the Bolton family. About the same time occurred several cases near by, on adjacent streets, alleged, on lay testimony, to have been yellow fever. The objection naturally arises that the distance is too great from the intersection of Front and Girod streets, and the interval of time too long from Elliot's case to those on Constance street, for a chain of evidence to be established between them. "It must be granted," says Dr. Choppin, "that we should naturally expect to find intervening cases, both in space and time, but we are here confronted by no greater mysteries than we find in other infectious diseases."

August 3d—The newspapers report the yellow fever on the increase.

August 10th—Yellow fever continues to spread.

Yellow fever, we thus find, made its appearance in New Orleans on July 12th, and assnmed epidemic proportions in the two latter weeks of July and the first week of August.

The maximum number of deaths occurred in the week ending September 13th.

The *day* of the greatest mortality was September 4th, 90 deaths.

Numbers of refugees fled from New Orleans to Granada, Miss., as they likewise did to so many, perhaps to every point along the railway leading north from New Orleans to Cairo, Ill. The number of stations enumerated by the Board of Experts along this line is 39, at only 16 of which yellow fever appeared, or about 40 per cent.

On the 10th of August it was reported that 35 persons were sick of yellow fever at Granada. The Memphis *Appeal* received assurances from two reliable sources that there was no yellow fever at Granada, but that the cases were "bilious fever." Nevertheless, on Aug. 17th, seven deaths by yellow fever and 15 or 20 new cases were reported, this time without the usual contradiction. The disease must be regarded as having taken root in Granada in the second week in August, just one month later than in New Orleans.

RISE OF THE EPIDEMIC IN VICKSBURG.

Aug. 11th—A fatal case, mentioned in the New Orleans dispatches, is said to have occurred, and to have originated in Vicksburg.

Aug. 13th—The Health Officer reports no new case to date.

Aug. 15th—Two new cases are reported by the Health Officer (authentic).

Aug. 16th—The Health Officer reports 3 new cases in Vicksburg.

Aug. 17th—There are 50 cases in Vicksburg; the disease is spreading rapidly.

Aug. 18th—48 cases under treatment; 15 or 20 new cases reported; no deaths.

Aug. 20th—200 cases of yellow fever under treatment in Vicksburg; 12 deaths during the past 24 hours.

Aug. 22d—"Epidemic very violent and malignant," says Dr. E. G. Banks.

In Vicksburg, therefore, the disease appeared between the 11th and 15th of August, and became rapidly epidemic by the close of the month. The first case occurred *twenty-one days* after the visit of the steamer J. D. Porter, on July 21st.

RISE OF THE EPIDEMIC IN MEMPHIS.

Aug. 13th—At a meeting of physicians in Memphis it was determined that there was as yet no cases of yellow fever in that city, except two men who had been landed on the Arkansas shore, and had crossed over to the city in a skiff. On *the same day*, however, a case of genuine yellow fever was reported at a lunch and bar-room frequented by river men. On this day, also, yellow fever is reported at Canton, Miss., and at Winona.

Aug. 14th—Yellow fever is spreading rapidly; two deaths, and 21 new cases. The epidemic is fairly begun.

Aug. 15th—33 new cases and 6 deaths.

From this date there was a steady increase in the number of cases and mortality. The disease was established in the 3d week in August.

RISE OF THE EPIDEMIC IN MOBILE.

Aug. 18th—The physicians question the genuineness of the case reported on the 16th inst.

Aug. 19th—The Health Officer certifies to the Board of Trade that there is no yellow fever in the city or surrounding country.

Aug. 31st—One death from yellow fever.

Sept. 6th—No yellow fever in Mobile.

Sept. 17th—2 fatal cases; another reported on Sept. 20th as an indigenous case, in the portion of the city bounded by Beauregard, State, and Conception streets.

Oct. 15th—It is reported that the first death was on August 15th; thence to October 7th, there had been 32 cases, 18 of which died. From Oct. 7th to 14th there had been 21 cases, and 4 deaths. The fever had, up to this time, been limited to the northwest part of the city.

Oct. 16th—15 new cases; the fever is evidently spreading.

Oct. 17th—6 deaths.

Oct. 19th—4 deaths.

Oct. 21st—4 deaths in the last two days. On the 22d, 4 deaths; on the 24th, 3 deaths; 46 deaths to date. On the 25th, 8 deaths; on the 28th, 4 deaths, and on the 30th 4 deaths, which were the last reported.

It will be seen that straggling cases occurred in Mobile from the 12th of August up to the first of October, and that about that time there was a manifest disposition towards extension of the disease. A limited epidemic is consequently noted, established wholly in the month of October.

THE EPIDEMIC IN LOUISVILLE.

Aug. 13th—The steamer J. D. Porter touched at Louisville with several cases of yellow fever on board; she afterwards moved on towards Cincinnati, where she was not allowed to land. Many cases occurred in the city in the refugees from infected localities; in all, 89 cases were treated at the yellow fever hospital, of which four were indigenous. The first of these (Sebastian Jonas) was admitted Sept. 27th. A case had previously

occurred on Sept. 16th. Dr. E. O. Brown, physician in charge, states that there were fifty or more cases originating in the infected district, bounded by Eleventh St., Maple St., and parallel alleys, where a new alley had been made, excavation with exposure of organic surface soil and of old privy vaults having been necessary for the work of grading. Of these 50 cases, 28 died. The depot of the Louisville and Nashville railroad was opposite the northwest corner of Maple and Eleventh streets, where a large amount of baggage of various kinds was stored. Many of the sick had been employed abont the depot. These indigenous cases appeared late in September and continued throughout the first three weeks of October. The epidemic was quite limited, both as to time and boundaries, but very malignant.

THE EPIDEMIC IN CAIRO.

Sept. 1st—No yellow fever in Cairo.

Sept. 9th—Two miles above Cairo, three of Tom Porter's family sick with yellow fever; the disease well defined. No yellow fever in Cairo itself. One of these cases died on Sept. 10th. The locality had been known to be very unhealthy for years, residents seldom escaping bilious disorders.

Sept. 12th—Tom Nally, editor of the Cairo Daily *Bulletin*, died of yellow fever in Cairo this day; one of the employes very sick with the disease.

Sept. 13th—Ike Mulkey, the above mentioned employe, died to-day. No new cases.

Sept. 15th—Two of the employes of the *Bulletin* office taken sick on the 13th, very low with yellow fever; one of these died after two days illness, the other on the 16th. No new cases.

Oct. 4th—Several suspicious cases, with two deaths.

Oct. 5th.—Two deaths.

The fever may now be regarded as epidemic. On the 6th we note 4 deaths; on the 7th 2 deaths; on the 8th 2 deaths; on the 9th 2 deaths, all the cases being confined to the "infected district." On the 10th 1 death; on the 11th 1 death; on the 12th 1 death; on the 13th 2 deaths; on the 14th 1 death; on the 15th 2 deaths; on the 16th 2 deaths; on the 17th 1 death; on the

18th we have to record the death of Dr. Waldo, Surgeon in Charge of the Marine Hospital, under whose care most of the sick had been placed. On the 19th 2 deaths; on the 22nd 1 death; on the 25th 1 death; on the 26th 3 deaths; on the 27th 2 deaths, which are the last reported by the newspapers; one more in the last week in October is reported by Dr. Charles W. Dunning, in a personal communication to the Secretary of the Medical Society of St. Louis.

According to Dr. Dunning's table, the maximum mortality was in the week ending October 19th, (12 deaths). The disease first became substantially epidemic in the third week in September, and prevailed thenceforth throughout the month of October.

YELLOW FEVER IN ST. LOUIS.

The facts in regard to the cases and epidemioform outbreaks upon the steamer Edwardsville, at Carondelet, and at Quarantine have been fully set forth. It has been shown that the fever at Carondelet was very distinctly comparable to the restricted epidemics of Louisville and Cairo, though of much smaller proportions than in either of those cities. A common circumstance is noticeable at each point where yellow fever prevailed in this city and neighborhood in 1878, viz., that the disease did not tend to affect the individuals exposed to it, except in two or three cases, before the end of September. It was at this time that the earliest of the Carondelet cases occurred. About two weeks later, viz., the second week in October, the culmination of this disposition was observable in the increased number of cases among citizens, and the employes at Quarantine. The last week of September and the first two weeks of October, must be regarded as the period in which the disease tended to establish itself in an epidemic form, as it would most probably have done had the predisposition necessary been acquired, a month or two earlier. The decline of temperature of the third week of October fortunately precluded all possibility of the establishment of a true epidemic. The first local case was that of J. Becker, the City Hospital nurse.

Recapitulating now the conclusions arrived at for the seven cities considered, in which yellow fever prevailed in 1878, and for which I have a weekly statement of the meteorological conditions, we have the following as a record, to which frequent reference will be made in the ensuing pages:

CITY.	Period of the Establishment of Yellow Fever.	Date of the first Local Cases.
St. Louis	23d of September to October 15th.	August 26th.
Louisville.....................	23d of September to October 15th	September 16th.
Cairo..............	15th of September to October 7th.	September 9th to 12th
Memphis....................	3d week in August.	August 13th.
Vicksburg	3d week in August.	August 11th.
New Orleans.................	Two last weeks of July	July 12th.
Mobile	First two weeks of October.	August 15th.

I here present a list of the years for Charleston S. C., whose meteorological and mortuary records will be compared with each other. The whole number of years is thirty-seven, and these are all, including 1878, for which the requisite data are obtainable, except by a personal visit on my own part, and computation anew from the daily books of record. The series is regular from 1832 to 1858, and is more or less irregular after this, nine of the years, as I have said, being deficient. I have made an effort to obtain the records for these years, but without success; their absence in no way, however, interferes with the propriety or significance of the system of inquiry to which those in my possession will be made subservient.

Years.	Hygienic Annotation.	No. of Deaths.	Years.	Hygienic Annotation.	No. of Deaths.	Years.	Hygienic Annotation.	No. of Deaths.
1878	Healthy.		1856	Yellow Fever.	212	1843	Yellow Fever.	3
1877	Healthy.		1855	Healthy.		1842	Healthy.	
1876	Yellow Fever.	30	1854	Yellow Fever.	627	1841	Yellow Fever.	Sporadic.
1875	Healthy.		1853	Healthy.		1840	Yellow Fever.	23
1874	Yellow Fever.	40	1852	Yellow Fever.	310	1839	Yellow Fever.	133
1871	Yellow Fever.		1851	Healthy.		1838	Yellow Fever.	350
1869	Healthy.		1850	Healthy.		1837	Yellow Fever.	1
1868	Healthy.		1849	Yellow Fever.	125	1836	(Cholera As.,	392
1867	Healthy.		1848	Healthy.		1835	Yellow Fever.	24
1866	Yellow Fever.	1	1847	Healthy.		1834	Yellow Fever.	49
1865	Healthy.		1846	Healthy		1833	Healthy.	
1858	Yellow Fever.	716	1845	Healthy.		1832	Healthy.	
185	Yellow Fever.	13	1844	Healthy.				

The population of Charleston has varied of late years. In 1835 it was estimated at 35,000, and reached 48,000 in 1861. In 1868 it seems to have declined to 35,000, but is now supposed to be over 50,000.

For the proper application of the system of investigation which will be applied to these Charleston figures, it is necessary to group the years according to the number of deaths by yellow fever. The rule I have followed is an arbitrary one, but in accordance with the usual mode of expression in Charleston and

elsewhere. Thus, where there have been no deaths by yellow fever, the year will be termed "healthy"; where the number of deaths by yellow fever has not exceeded thirteen, the year will be called "sporadic"; where the mortality by yellow fever has ranged between thirteen and one hundred and twenty-five deaths, the year will be classed as "least epidemic"; and where the mortality exceeded this latter figure, as "great epidemic." These designations being fixed in advance for *Charleston*, must be adhered to throughout. The absolute number of deaths occurring in any year is of no paramount significance, but as these numbers have been fixed upon as accurately as possible, not merely for the purpose of truthfully denoting the comparative unhealthiness of different seasons, but in order to define a series of *four groups of years*, whose hygienic affix may denote these incremental grades of the prevalence of yellow fever beyond the level of "health," it is obviously necessary that no change of affix is possible. We thus have four nosological groups of years, *quoad* yellow fever; it will be seen that as the intensity of the yellow fever annotation rises, as denoted by the affix, so also will the meteorological intensities of all the true causes of yellow fever. The groups of years are as follows:

A TABLE SHOWING THE NOSOLOGICAL GROUPS OF YEARS IN CHARLESTON, S. C.

Six Greatest Epidemic Years.		Five Least Epidemic Years.		Five Sporadic Years.		Nineteen Healthy Years.	
1858	716 deaths.	1876	30 deaths.	1866	1 death	1878	1850
1855	212 deaths.	1874	40 deaths.	1857	13 deaths.	1877	1848
1854	627 deaths.	1849	125 deaths.	1843	3 deaths.	1875	1847
1852	310 deaths.	184	23 deaths.	1841	Sporadic.	1867	1846
1839	133 deaths.	1835	24 deaths.	1837	1 death.	1868	1845
1838	392 deaths.	1834	49 deaths.			1869	1844
1836	Chol. 392 deaths)					1865	1842
						1855	1833
						1853	1832
						1851	

In 1850 the dengue or "breakbone" fever prevailed extensively, but there were no recorded deaths by "yellow fever." I regard this disease as a hybrid between yellow fever and catarrhal fever, as one of its names, "catarrho-bilious fever," somewhat implies; the year is consequently classified as a "healthy year" *quoad* yellow fever. In 1836 Asiatic cholera prevailed with 392 deaths; there was not a case of yellow fever. This year has, however, been classified as a greatest epidemic year,

but will never be included in the group, unless so expressly stated. As it cannot be introduced into the "healthy" years, in which no epidemics prevailed, but only such affections as catarrh, measles, or dengue, it will be omitted altogether from consideration, except when, in passing, it will be instructive to observe the high temperature and fairness of the days which qualfied the cholera season.

I must now briefly explain the principles according to which this investigation will be conducted.

About the year 1854, becoming interested in the etiology of yellow fever, after a general study of its history in Charleston and elsewhere, I became satisfied that we could arrive at no definite conclusions by ordinary methods of investigation. Facts were stoutly claimed and as stoutly denied by those who held opposite opinions with regard to the nature and contagiousness of yellow fever, nor was there any way of directly estimating the actual strength of the conclusions reached on either side. I was thus led to examine the meteorological figures, having a long series of years, recorded under the same system and by very reliable observers under the authority of the city, to compare with each other. After a number of very laborious but abortive efforts to determine a single figure, or "pestilential coefficient" for yellow fever, calculated from the several meteorological elements, I determined to apply a system which I have denominated "proof by the coincidence of the extremes and concurrent progression of the means," or the establishment of *primary agents, in the production and prevention of yellow fever.* With this system I was successful, in what degree will be seen from the abstracts drawn from these researches, as yet unpublished, but now brought up to date by the addition, lately, of all the years it is possible to obtain. What this system is, and what degree of probative power pertains to it, I shall now briefly indicate, premising that as all my most important conclusions with regard to the nature and origin of yellow fever were reached in the progress of these investigations, and are still to a great extent founded upon their results, my purpose in introducing short abstracts from them into this analysis, is to show, when considering each meteorological element in detail, the real significance of the figures when studied by the system alluded to, and thus render it easier for the reader to appreciate their value when they are estimated from periods

of time far more limited than what we have at command in the records of Charleston. The usual method of demonstration, in researches of this kind, is that of "parallel movement," an example of which may be seen in our study of the relations of sunstroke to heat and humidity, of yellow fever to malarial fever and to "all fevers," and of its converse, or "opposite movement," in our comparison of cholera sporadica with malarial diseases. This system is only applicable with success, when the relationship between the two sets of data, either mandatively or prohibitively, is direct, and under such circumstances may be employed for very limited periods of time. Its success depends essentially upon the non-existence of perturbing influences.

The system by parallelism, moreover, is the only one which can be employed where the number of years compared is too small to give accurate means, either of the meteorological or nosological intensities, but even here, will be found significant enough if any year of a series has been extraordinarily intense in either of these aspects. As such was the case in the year 1878, the yellow fever prevailing more widely than ever before in the West and Southwest, with most unusual exaggeration of the meteorological conditions nearly everywhere, I shall adopt this system in dealing with the records for the five years from 1874 to 1878, particularly, as from the uavoidable shortness of the period of time submitted to examination, no correct indications can be drawn from a consideration of the means of any two or more of these years.

The series of years recorded in Charleston is so long that the indications of the parallelism of the extremes can be tested by examining the movement of the means of the several nosological groups, thus enabling us to determine positively whether any inherent parallelism resides in a given series of figures or not.

Every composite effect is the result of both causative and opposing agencies, which are arrayed against each other. The nature of the effect differs with the preponderance of the combined influence of one class of agencies over the other. Each of these etiological classes must, moreover, contain agencies which vary in power, and which are still further dispensable or indispensable. We also find that the influence of many very powerful agencies is not exerted upon the effect directly, but upon it only through the intermediation of some other causative agent.

Each division of causes is thus divisible into (*a*) primary or indispensable causes, and (*b*) secondary, or even tertiary, causes. When a primary agent is at its maximum of action, it produces its customary result with but little concurrent aid from the secondary causes, and in despite of even strong adverse action on the part of the antagonistic causes. So, also, when a primary agent is at its minimum of efficiency, or totally inactive, the known result cannot possibly occur, notwithstanding a high degree of activity in the secondary causes, or absence or great inactivity of the opposing causes. Such primary agencies, are main influences in the production or prevention of an effect; they are *causæ sine qua non*, as well as causes of absolute mandative power, under given conditions, which act concurrently with them as secondary and tertiary influences.

An investigation like the one in which we are engaged, is a search after such primary agents. It must be borne in mind that primary agencies vary as the result, where this is composite, though not for every incremental degree of the result. While their power is uniformy manifest at the extremes of intensity, medium degrees of such intensity cannot be expected to exhibit a close parallelism with the development of the result, but the means of any fractional part of a sufficiently long series of increments will show by their own parallel increase that the indications of the extremes are the effect of the constant, indispensable, and irrepressible power of the agency whose action it expresses.

An influence is thus recognized as a primary agency in the production of a result, when this result is coincident with the maxima of the incremental series of figures denoting the activity of the agent, and absent at the minimum of the series, and when the sum or mean of all these figures which are qualified by the result, is in excess of the sum or mean of all those against which the result is not placed,—and the recognition becomes absolute, when the progression of incremental groups of such results is in accordance with that of the means of the figures of the incremental series which properly belong to such groups. An influence is recognized as a secondary or tertiary agency when the maxima and minima of the incremental series coincide with the presence and absence of the assumed effect, and when the means of its figures properly belonging to groups of results already known to be progressive, are found to vary in strict par-

allelism with these last, while at the same time, collateral reasoning plainly shows that the relation of such an influence to the result, must from its nature depend upon the connection existing between such an influence or agency, and a primary agency already established.

The recognition of agencies in the prevention of a result, is effected by an exactly converse method.

Such is the theory of the mode of investigation which I have applied to the Charleston data; it consists essentially in the establishment, by an analysis of various columns of meteorological increments, of the coincidence of the extremes, and the concurrent progression of the means of the proper figures, with the extremes and means of the grouped incremental results respectively.

The underlying hypothesis, with regard to the etiology of yellow fever, to be proved or disproved, is, that the disease is caused by the known agencies of putrefaction in the presence of abundant putrescible matter. To establish this hypothesis it will be necessary to demonstrate that the primary and secondary agencies in the promotion of putrefaction upon the surface of the earth, are also primary and secondary agencies in the production of yellow fever, and conversely, for the primary and secondary influences which prevent common putrefaction, which should also prevent yellow fever.

The conditions of putrefactions are so well known, that for a recognition of its primary and other agencies of both kinds, it is not at all necessary to have recourse to systems of figures. Innumerable observations of a scientific character upon the modes of fermentation and putrefaction, and the constant attention paid to such processes in the arts as well as in the familiar duties of life, leave us but little to desire with regard to a knowledge of the fundamental conditions of all kinds of fermentation. We know when this process will take place; we know how to arrest and promote it, and we are familiar with the conditions under which it will not be established.

It will not be amiss to enumerate these conditions in a very few words. As is so well known, they are oxygen, or exposure to the air, heat and water. When these three agencies concur in any proportions, decomposition of organic matter must take place with a rapidity and completeness depending both on the fermentescibility of the compound, and upon the intensity of each of the causes.

Exposure to the air, or due access of oxygen, is a condition which is universally attendant upon the modes of putrefaction which concern sanitary science. All fluids and solids of a putrefiable nature (colloidal) derived from organized beings, contain oxygen enough for the inception of putrefaction; further consideration of this agent may, therefore, be dismissed.

At the freezing point, or below it, putrefiable matter remains absolutely unchanged for any length of time. Tendency to change is greatly diminished without absolute freezing, but the fixation of the water contained in the structures of the matter concerned, or holding them in suspension or solution, by congelation, seems to be indispensable to a total prohibition of the process. There is then, practically no water present, for it has become transformed into *ice*.

At a higher temperature than 32° F. the phenomena occur with a promptness and activity which vary with the enhancement of temperature. Substances of soft and juicy texture, such as fish and young meats, putrefy much more rapidly than less succulent ones, as they contain a greater proportion of dissolved albumen. Blood decomposes with great facility; at the temperature of the body, three hours is sufficient to establish the process, as I have found in numerous experiments in which this point was a prominent one. The most putrefiable of all matters, however, are the excrementitious products of the animal economy. So great is their proclivity to change, that they very often do so in part before expulsion from the body. As they are naturally destined by disruption to subserve the necessities of the vegetable kingdom, so these excrementitious matters appear to be very early impressed with a powerful disposition towards molecular rearrangment. The putrefaction of the semi-solid and liquid excrements of animals, begins with a readiness which it is almost impossible to avert or control in a hygienic sense, and gives rise to a greater amount of gaseous matter and volatile effluvia noxious to man, than any other class of putrefiable substances whatsoever.

The third and last essential of decomposition, is water; no decompositive change of the nature of those under consideration can occur without its adjuvancy; it is as indispensable as heat or oxygen. When an adequate supply of water is at hand, putrefaction follows its normal course if the temperature be favorable; but if water be too abundant or too scanty, the nature of the

putrefactive process is somewhat changed, but it is never wholly arrested, save by absolute dessication. When water is present, in whatever quantity, if the temperature be suitable, putrefaction will surely occur. This is seen in the putrefaction of the waters of even the Mississippi river, when allowed to stand for a day or two in summer; notwithstanding the very small proportion of organic matter existing in this potable water, putrefaction will begin and advance in it as soon as its temperature reaches 80° or 90°, its products accumulating and becoming sensible to the olfactory sense. While in *motion* in the river, aeration, due to the chafing of the stream against obstacles in its course, and to the influence of winds, and facilitated by wide exposure to the atmosphere, produces oxidation and destruction of these products of the putrefactive process, which is necessarily in progress whenever the temperature of the river, or of its expansions over shallow surfaces or in disused channels, reaches the grade of summer heat. If the air be devoid of ozone, or unusually calm, the gaseous and other products of putrefaction from waters charged with organic matter, become commingled with the atmosphere.

The substances whose putrefaction it behooves the hygienist to study, may be derived from the animal or vegetable kingdom, or they may be of mixed nature, as indeed they usually are. As the constitution of putrefiable matter differs, according to their origin, so likewise does that of the substances or groups of substances into which they are more or less completely dissolved.

The substances of unmixed animal origin most commonly met with by the sanitarian, are blood, skins, glue, animal and human fæces, and urine, and the bodies of men and of domestic animals. The decomposition of such matters, evolves not only the well-known gases and volatile substances, but is accompanied by the emanation from the surface of the putrescent mass, of a certain quantity of its own changing material in a condition of exceedingly fine pulverization or *atomization*. It is by such matter that the sense of smell is mostly affected, like the sense of taste, and it is by *such minute particles,* consisting of the putrefying substance itself in minute quantities, that human health is directly assailed, the *gaseous* effluvia being also highly detrimental to life and health. The act of smell is a process of tasting, and we can readily understand how, under such circumstances, the putrefaction advancing without, may be kindled in the human organism

by the immediate contact and absorption of particles in a state of septic activity.

The substances of vegetable origin whose decomposition concerns us most, are the flour or grain of the cereals, which often run to waste and putrefy in the damp or inundated cellars of cities; leaves, hay, garden herbage, and the mud of ponds and swamps.

The bodies of mixed origin, are the drain-water and mud of cities, the mud of cisterns in cities; the surface soil of unpaved streets, alleys and court-yards; the contents of lagoons liable to overflow by the seaside; of still or stagnant lakes or bayous; the contents of ponds and low areas without adequate drainage, both in the city and in the country, in the neighborhood of human habitations.

Each substance of either of these classes, emits in putrefaction, some products more abundantly than the rest, according to its chemical composition, which is characteristic, to a certain extent. The putrefaction of blood, for example, gives rise to large quantities of gaseous sulphides; that of urine, fæces and sweat, to ammoniacal products; of fish to phosphides of ammonium and hydrogen. The decomposition of the mud of drains, to sulphide of hydrogen, marsh gas and carbonic acid. Fermenting masses of herbage liberate carbonic acid, carbonic oxide, and sulphides in small quantity. All of these products are inimical to animal life, the sulphides, phosphides, and ammoniacal compounds being especially noxious. They act apparently by impairing the nutritive processes generally, and depraving the blood. The sulphides, there is every reason to believe, destroy the blood corpuscles directly, while carbonic oxide paralyzes them. The action of these gaseous products upon the economy, in conjunction with the high heat and humidity which is necessarily attendant upon the processes to which they are due, is to produce a general perversion and depravation of the nutritive processes, strongly disposing towards fever, or even to set up simple modes of fever, which may assume, however, a septic character in very exceptional cases, in virtue of abnormal conditions of the economy itself. These gaseous matters are not the essential cause of the grave septic fevers, or of yellow fever in particular—most septic and malignant of all; but their presence in the air must be regarded as one of the very strongest *predisposing conditions* to such fevers.

The direct kindling of yellow fever is to be attributed, in my opinion, to imbibition, by the lungs and perhaps by the digestive system, of the minute particles of decomposing matter, in proper kind, already mentioned, in virtue of which, septic processes advancing in putrefying foci on the surface of the earth, are *directly* transferred to the human fluids and solids, in an economy already predisposed toward the febrile state, as already briefly explained. These points I wish to state very clearly, to avoid misconception. This *transferred* septic matter acts exactly like the materies contagiosa itself; both are particulate; neither of them germinal, both are yeast-like, derived from substances in a condition of fermentative change; both alike require a previous predisposition or susceptibility for the manifestation of their properties; both alike, finally, are undoubtedly possessed of varying degrees of potency and the power of inducing predeterminate modes of change in the human organism, in all respects, perhaps, similar to those in which they themselves originated. These are the attributes of every particle of every fermenting mass.

It will be observed that I said nothing about "germs." I do not see any reason to believe that putrefaction, a world-wide process, the grand complement of *composition*, in steady progress from the death of the first living fragment of protoplasm to the present time, the only natural route whereby matter can sweep through its ceaseless cycle of integration and disintegration,—whereby inefficient and failing forms of organic life are dissolved into dust and thin air, under the moulding hand of nature to appear in new, more varied and more accurately adjusted embodiments, is due to the implantation of germs in fermentable matter. Nor can I believe for a moment, that so indispensable and majestic a process could possibly be dependent upon the chance of a deposition of sporules or any kind of germinal matter. A multitude of facts, moreover, entirely preclude our acceptance of any such narrow dogma, which has been imposed upon us by the anatomists, botanists and microscopists, while wholly at variance with the broad principles of organic and physiological chemistry. Here Justus Liebig still reigns, and in my opinion, will continue to rule for ever; *germs* are not the causes of putrefaction, but its accompaniments and products. The minute organisms, now so freely talked about, take their origin in the excitement and chemical commotion which belongs, in its very essence,

to the fermentative state, appearing now, in our days and under our eyes, as they did upon the shallow shores and slimy ooze of the primeval waters, under the impulse of a creative power inherent in nature, then, now, and henceforth, by an act of creation, which not only steadily sustains all things, but perpetually reproduces the simplest "beginnings of life," even in the phials and flasks of Pasteur, Tyndall and Bastian.

Having thus very briefly stated the principles which must govern an investigation like the present one, I pass on to a succinct consideration of the meteorological conditions in detail. In each case I shall present abstracts from my researches upon the etiology of yellow fever in Charleston, for reasons already assigned, and as I have said, will employ for these latter the system of analysis which I have described as a search after "primary agents." For the five years of record and the eleven cities, we shall be obliged to content ourselves with the simple system of "parallelism."

In the Charleston records, the three months—August, September and October,—are considered conjointly, separately, and in combination with each other; these months constitute what may be denoted as the "yellow fever season," since yellow fever never becomes epidemic in Charleston earlier than the month of August, at least according to the statistics of forty-two years, which I have searched. In the Southwest and West, however, yellow fever may appear in July, seldom if ever becoming epidemic before that month, and I have consequently considered the four months July, August, September and October, as the "yellow fever season," or "summer" in the records for the eleven cities.

THE TEMPERATURE.

For the purposes of epidemiological investigation, it is strictly necessary to be provided with figures expressing, for various hours of the day and night, the proper *heat of the soil or surface of the earth*, as everything in contact with this surface tends to assume its temperature. Thus the temperature of the air, of fluids and solids in contact with the earth, of buildings, and even the body of man himself, is directly controlled by the temperature of the soil on which they rest. No such record, however, is attainable, and we are obliged to remain content with a record of the temperature of the air *near the earth*.

The temperature of the surface of the earth is maintained by:

1st. The proper or intrinsic heat of the earth's interior mass.

2d. By the heat of the stars, which Pouillet has estimated as but little inferior to that of the sun itself.

3d. The sun's radiation—whose power is calculated as competent to melt a mass of ice 103½ feet in thickness over the entire surface of the globe in each year.

The conditions affecting the temperature of the earth's surface, are mainly the following:

1. Return radiation, by day and night.
2. Latitude.
3. The position of the earth in its orbit, or the season of the year.
4. The presence of spots or faculæ upon the sun's surface.
5. The fairness of the days and nights.
6. The cloudiness of the nights.
7. The humidity of the air.
8. The pressure of the atmosphere, or altitude above the sea level.
9. The steadiness of the surface.
10. The density of buildings.
11. The color and composition of the soil.
12. Undulations and irregularities of the surface.
13. Aerial convection.
14. Winds.
15. Evaporation of water.
16. Precipitation of rain, snow, or hail.
17. Inundations.
18. Proximity of bodies of water, and mountainous regions.

When the surface is covered by water, shallow collections alone concerning us at present, if the water is motionless, it soon becomes heated to a temperature approaching that of the solid surfaces near by, but if in motion, it yields to seasonal and geographical influences. It is obvious, from the long list of conditions alone detailed, that a bare mention of them must suffice.

The calorific power of the sun, so far as this depends upon its altitude, in our hemisphere, is greatest on the 21st of June and least on the 22d of December. On the 21st of June, the northern hemisphere would thus, as first sight, seem to have attained its maximum of heat, and the temperature of the earth should decline, it might be thought regularly towards the north

pole. It is found, however, that the highest heat is reached about the end of July or beginning of August; at that time, for a short period, instead of diminishing towards the pole, the temperature actually varies in the opposite direction. This unexpected fact is attributable to the sphericity of the earth and to the *accumulation* of heat. If the earth did not turn upon its axis, the influences of the sun alone, by such accumulations of its effects, would be powerful enough, very soon, to kindle a universal conflagration on the surface exposed to its action. We see an effect of this kind in the desolate character of the moon's surface, which revolves upon its axis only once in twenty-eight days. But as the diurnal revolution of the earth is accomplished with far greater rapidity, radiation at night counterbalances the effects of the constant action of the sun by day. The heat of the earth's surface, in this respect, is consequently determined by the number of hours of sunshine in a day or season, as opposed to the number of hours of night.

The maximum effect of the sun's radiation is attained sometime *after* a given spot has passed the meridian, and some weeks after the sun has attained its greatest northern altitude. Then the varying length of the days modifies the effect of the angle of insolation. When the sun is north of the equator the days are longer than the nights, and when the sun is south, the reverse obtains. Taking the temperature of the months, the highest point in the northern hemisphere is everywhere reached, as a mean of several years, in the month of July, the second or third week of that month, or even later. The following table shows the monthly mean of temperature in Charleston, which I have calculated from a series of twenty-six years:

	Jan.	Feb.	M'ch	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Means.....	50.40	52.33	57.69	64.88	73.34	78.81	81.46	80.79	72.62	66.81	58.19	51.87

July is the hottest month, though but little in excess of August; January is the coldest, for reasons which are the obverse of those explained in connection with the maximum of monthly temperature. The high temperature of the month of June will be noticed, only 2.61° below that of July. As yellow fever very seldom occurs in Charleston before the third week in August, we have thus about eighty days in which the temperature, as a mean of a long series of years, ranges in the neighbor-

hood of 80°. In those years in which yellow fever prevails, the mean temperature of these eighty days is higher still. We shall find epidemic seasons are the hottest of all. The effect of this long continued heat, upon the economy, is shown in a general exhaustion of the forces due to an unusual stimulation of the nutritive processes, in all cities where the annual mean temperature is high. The air becomes laden with humidity, whose influences, by preventing proper refrigeration of the body by the appropriate mechanism of the evaproation of the sweat, becomes equivalent to additional increments of temperature. Under the continued effects of an exalted and maintained heat and humidity, decomposition of all kinds becomes more active and its products being absorbed by the system, still further impair its reactive powers, and tends to establish a predisposition to fever. If now, the nights be calm, and foci of purtrefaction abundant, no very long period of time elapses before some one individual whose predisposition is exaggerated, or who has lately arrived from regions where his system has never before been called upon to exert itself so strenuously in reactive antagonism to assaults of so high a grade, becomes affected by the putrescent effluvia, and becomes ill with a bilious fever of septic character. A little later, others are still more profoundly affected, some of them vomiting grumous, blackened flakes; later still, the affection is characterized by distinct and unmistakable black vomit. Such is the usual course everywhere. The first cases are called maligannt, the later are disputed, until difference of opinion is no longer possible. So also, if an individual, predisposed towards fever, as above stated, comes into contact with the materies contagiosa of a previous case, on account of the power which this contagious element possesses of at once stamping the system with all those peculiarities of morbid action in which it was itself begotten,—we more often have a fully declared, unmistakable case of yellow fever, with black vomit, from the begining; yellow fever "*d'embleé.*" The gradually increasing severity of the earlier cases, and the absence of black vomit in the first cases, even when fatal, fully explains the differences of opinion almost invariably expressed by local practitioners as to their true character. Year by year, and whenever yellow fever appears, we encounter a similar contest of opinion which would not be engaged in so prominently, were this distinctly gradual development of yellow fever properly appreciated. Even in early cases indisputably due to

the influences of contagion, the symptoms are somewhat obscure, at times. Turning now to the Charleston records, I present the following tables of increments of temperatnre in which the several months of the summer are differently grouped, viz.: 1st. August and September. 2d. September and October. 3d. August and October. All of these are based upon the 7 A. M. and 2 P. M. registrations, the minima and maxima of daily temperature, while the later tables of temperature which follow these, will be based upon the 7 A. M., 2 P. M. and 9 P. M. registrations. These latter tables will therefore express the *true mean temperature*, while the first six of the series express only an arbitrary mean temperature which is not reliable as a record, though perfectly so for the purposes of comparison which concern us here. In this way we have quite a number of variations of the temperature figures. It will be found that, however varied, and into whatsoever combinations thrown, the indications of them all are identical. To show that this is so, is the object of the variation, which indeed I have practiced in a great many more forms than shown here, and always with identical results. I now present the following:

Table A: showing the increments of temperature, calculated from thirty-four years, from the 7 A. M. and 2 P. M. registrations for the months of August and September conjointly. The years 1875 and 1876 are calculated from the morning and afternoon observations of the Signal Service.

Years.	Temp	Hygienic Annotation.	Years.	Temp.	Hygienic Annotation.
1836	85.58	Cholera.	18 6	79.16	....
1838	83.29	Yellow Fever.	1850	79.03	....
1840	82.45	Yellow Fever.	1853	78.71	....
1337	81.73	Yellow Fever.	1843	78.66	....
1855	81.31	....	1832	78.65	....
1834	81 15	....	1857	78.63	....
1868	80.66	....	1847	78.60	....
1833	80.51	....	1867	78.59	....
1876	80.45	....	1851	78.01	....
1854	80.43	....	1858	77.81	....
1869	80 38	....	1875	77.70	....
1841	80.05	....	1852	77 38	....
1846	80.02	....	1844	77.01	....
1839	79 94	....	1849	76 96	....
1835	79.69	....	1848	76.92	Healthy.
1866	79.43	....	1845	76.37	Healthy.
1865	79.17	....	1842	76.12	Healthy.

The maximum is found in the cholera season. The three next highest maxima are yellow fever years. The minima correspond with healthy years. Subjoined is a table showing the movement of the means of the nosological groups, the cholera season being omitted.

Table B, showing the progression of the means for Table A:

Epidemic Years.	Sporadic Years.	Healthy Years.
Mean.................. 79.8[illegible]	Mean. 79 7	Mean 78.23

The progression is regular, and corroborates the indications of the preceding table. We therefore conclude that *the mean temperature is a primary or indispensable agent in the production of yellow fever.*

I next present a pair of similar tables for September and October, conjointly.

Table C, showing the increments of temperature for thirty-four years, calculated from the 7 A. M. and 2 P. M. observations, and for the months of September and October, conjointly. The figures for 1875 and 1876 are calculated from the "morning and afternoon observations" of the Signal Service, viz., 7.24 A. M. and 4.24 P. M.:

Years.	Temp.	Hygienic Annotation.	Years.	Temp.	Hygienic Annotation.
1840	76.83	Yellow Fever.	1867	72.15	....
1837	75.76	Yellow Fever.	1842	72.00	....
1866	74.85	Yellow Fever.	1832	71 90	....
1834	74.62	Yellow Fever.	1843	71.89	....
1839	74.46	Yellow Fever.	1844	71.43	....
1836	74 26	(Cholera.)	1841	71.31	....
1868	73.90	....	1850	71.25	....
1838	73.55	....	1835	71.18	....
1869	73.55	....	1849	71.15	....
1833	73.34	....	1853	71.11	....
1852	73.09	....	1848	71 05	....
1865	72.82	....	1851	70.93	....
1854	72.87	....	1856	70.71	....
1846	72.54	....	1876	70 32	....
1847	72.40	....	1857	70.02	....
1855	72.32	....	1845	69.64	Healthy.
1858	72.16	....	1875	69.22	Healthy.

The maxima indicate yellow fever seasons, and the minima healthy seasons.

I present, below, the corresponding table of the means.

Table D, showing the movement of the means for Table C:

Epidemic Years.	Sporadic Years.	Healthy Years.
Mean .... 72.8[illegible]	Mean .... 72.7[illegible]	Mean 71.86

The progression is regular, although the difference between the means of the sporadic and epidemic years is but slight. We must recollect that, in consequence of the omission of the 9 P. M. registration from these tables, the general and exceptional grades of temperature are reduced below their true figure, the 9 P. M.

temperature being naturally intermediate between that of the morning and afternoon.

I present a pair of tables of similar character for August and October conjointly, September being purposely omitted.

Table E, showing the increments of temperature for thirty-four years, calculated from the 7 A. M. and 2 P. M. registrations, and for the months of August and October conjointly. For the years 1875 and 1876, the temperatures have been calculated from the "morning" and "afternoon" observations of the Signal Service:

Years.	Temp.	Hygienic Annotation.	Years.	Temp.	Hygienic Annotation.
1837	78.81	Yellow Fever.	1846	73.83	....
1834	76.85	Yellow Fever.	1832	73.64	....
1839	76.58	Yellow Fever.	1866	73.57	....
1836	76.58	(Cholera).	1853	73 54	....
1840	76.38	Yellow Fever.	1867	73.46	....
1858	76.08	Yellow Fever.	1850	73.27	....
1838	76.04	Yellow Fever.	1844	73.25	....
1869	75.94	....	1865	73.17	....
1835	75.64	....	1848	73.16	....
1852	75.30	....	1876	72.77	....
1854	75.05	....	1841	72.72	....
1847	75.05	....	1843	72.41	....
1851	74.79	....	1857	72.23	....
1832	74.52	....	1875	71.82	Healthy.
1856	74.34	....	1845	70.88	Healthy.
1849	74.28	....	1842	69.87	Healthy.
1855	74.12	....	1868	68.18	Healthy.

The maxima coincide with yellow fever years, and the minima with healthy years. Subjoined is the accompanying table of the means:

Table F, showing the progression of the means for Table E:

Greatest Epidemic Years.	Least Epidemic Years.	Sporadic Years.	Healthy Years.
Mean 75.56	Mean 75.18	Mean.......... 73.95	Mean 73.38

The progression is regular, and corroborates the indications of the previous table. According to this record also, therefore, the temperature is a primary agent in the production of yellow fever.

I present, in the next place, a pair of tables for the proper yellow fever season in Charleston, viz., the three conjoint months, August, September and October, in which the figures given are the true means of temperature, being based on the three daily observations.

Table G, showing the increments of temperature, calculated from the day and night means of the register thermometer for those years through which this record extends, and for years previous or subsequent to this, from the 7 A. M., 2 P. M. and 9

P. M. registrations, and for the months of August, September and October conjoinly, for thirty-seven years:

Years.	Temp	Hygienic Annotation.	Years.	Temp.	Hygienic Annotation.
1836	77.17	Cholera.	1858	74.84	....
1834	76.96	Yellow Fever.	1856	74.62	....
1840	76.91	Yellow Fever.	1847	74.37	....
1839	76.38	Yellow Fever.	1832	74.34	....
1838	76.28	Yellow Fever.	1853	74.26	....
1877	76.20	....	1848	74.17	....
1854	76.10	....	1841	74.15	....
1837	75.83	....	1843	74.05	....
1835	75.45	....	1846	74.03	....
1850	75.37	....	1876	74.00	....
1869	75.33	....	1867	73.78	....
1833	75.27	....	1874	73.56	....
1855	75.24	....	1857	73.52	....
1868	75.19	....	1844	73.22	....
1878	74.94	....	1849	72 98	....
1865	74.94	....	1842	72.55	Healthy.
1852	74.92	....	1875	72.35	Healthy.
1851	74.90	....	1845	71.80	Healthy.
1866	74.89	....	....	....	....

The maxima of temperature exhibit their influence in the annotation of "yellow fever" to the four next highest figures. The cholera season of 1836 heads the season; this was the hottest ever known in Charleston. The other figures to which there is no annotation, as in all these tables, indicate years in which yellow fever sometimes prevailed or did not. Their indications are unimportant, as the table is intended to show the power of the temperature in compelling the existence of health at its minima, and of pestilential seasons at its maxima only. By the theory of this mode of proof, the indications of the middle figures of an incremental series are unimportant.

Table H, showing the progression of the nosological means for table G:

Greatest Epidemic Years.	Local Epidemic Years.	Sporadic Years.	Healthy Years.
Mean, 75.52	Mean, 74.98	Mean, 74.45	Mean, 74.33

The progression is seen to be regular. The average temperature of the healthy years is less than that of the sporadic years. The mean temperature of the sporadic years is lower than that of the least epidemic years, and the temperature of the greatest epidemic years is the highest of all. This table is therefore strictly confirmatory of all the foregoing tables, and especially of Table G, and proves beyond all dispute that the mean temperature is a *primary agent in the production of yellow fever*; not merely *a condition of yellow fever*, but a resistless cause thereof. The influence of other conditions is recognizable in

the perturbation of the middle figures of each incremental series. The temperature is, therefore, a cause without which *yellow fever cannot exist*, at whose maxima yellow fever in intensity of some degree, though not of necessity of the highest degree, *must exist*, provided moisture and putrefying matters are concurrently present, and a causative agent, whose efficiency is proved by the march of the nosological groups, in strict parallelism with the means of the temperatures of those groups respectively. The cholera year has been omitted from Table H because the inquiry is not concerning the etiology of that disease; and this year cannot with propriety be included in the list of healthy years, not even *quoad* yellow fever. Had it been placed among the greatest epidemic years — which would be proper, perhaps, in some respects — its figure, highest of all, would only have heightened the mean for such years in Table H.

I present, finally, a pair of tables in which the temperature for the months of August, September, October and November are compared. It will be seen that in yellow fever seasons, even in the month of November, when the cases are few and epidemics rapidly disappearing, it is usually hotter than in healthy seasons, and that the variations of its figures are not pronounced enough to affect means based upon a combination of the three previous months, such as we have just considered.

Table I, showing the increments of temperature, calculated from the day and night means of the register thermometer for all the years through which this record extends, and for years previous to this, from the 7 A. M., 2 P. M. and 9 P. M. observations, and for the months of August, September, October and November conjointly:

Years.	Temp.	Hygienic Annotation.	Years.	Temp.	Hygienic Annotation.
1837	74.12	Yellow fever.	1833	70.64	....
1835	72.81	Yellow fever.	1865	70.60	....
1834	72.36	Yellow fever.	1866	70 48	....
1855	71.98	....	1851	70.42	....
1840	71.91	....	1844	70.35	....
1838	71.44	....	1832	70.33	....
1850	71.41	....	1846	70.28	....
1839	71.39	....	1868	70.22	....
1847	71.21	....	1849	70.20	....
1867	71.13	....	1843	69.94	....
1854	71.04	....	1857	69.44	....
1869	71.04	....	1876	69.30	....
1856	71.01	....	1875	69.06	....
1853	70.92	....	1858	68.94	....
1841	70 89	....	1848	68.90	Healthy.
1852	70.70	....	1842	67.70	Healthy.
1836	70.70	....	1845	67.37	Healthy.

The maxima correspond to yellow fever seasons, and the minima to healthy ones. I present also, below, the companion table of the means.

Table J, showing the progression of the means of the nosological groups, for table I.

Epidemic Years.	Sporadic Years.	Healthy Years.
Mean, 71.01	Mean, 70.97	Mean, 70.21

The progression is regular, and corroborative of the indications of the companion table, I. The month of November, in Charleston, does not properly belong to the yellow fever season, as the cases which occur in that month are almost exclusively due to infection at previous periods. Nevertheless, the inherent strength of the figures is such that they are able to bear even this test.

These tables demonstrate, with an authority which admits of no question, that high heat is one of the primary causes of yellow fever. That when the heat is unusually high and long continued, *other meteorological conditions*, especially stagnancy of the air concurring, yellow fever will necessarily appear, and conversely, that at the lowest temperature known at Charleston, yellow fever *cannot originate, nor spread, nor be engrafted by importation.*

We must recollect that when yellow fever has originated in the midst of very hot weather, on account of its proper contagious character, it will become disseminated, although the mean temperature decline so greatly as to reduce the general mean of the month, or even of the particular season, to a point lower than that of the mean of years in which no yellow fever has occurred. The fact remains true, nevertheless, that the fever would never have existed without the agency of the excessively high temperature, an assertion which we have been happily able to substantiate in consequence of the action of a meteorological law which determines that a season which is very hot in July and August, will continue, almost invariably, to be hotter than its mean until December. Thus it is, that yellow fever seasons are almost always longer than usual, and the desired frost is postponed by the activity of the very causes which have generated the disease and still sustain it.

Having now considered the agency of temperature in the generation of yellow fever in Charleston during the last forty-

seven years, I proceed to examine the data in my hands relating to the great epidemic of the West and Southwest in 1878. The series, which is the longest for which records can be obtained from each of the eleven cities, viz., five years, is still altogether too short to admit of any elaboration of means of groups of years, as has been possible for the long series of the Charleston records. We can only use the system of parallelism or comparison, and in some instances note distinct progression. The figures are in most cases so pronounced, in consequence of the inordinate intensity of the meteorological elements of 1878, that it will be easy to seize their most prominent indications.

I subjoin a table of the mean temperatures for each of the four summer months, with the monthly, seasonal, and great seasonal means, for each of the eleven cities. This table, and others like it, to follow, have been abstracted from the published annual reports of the signal officer, except for 1878, not yet published. The figures for this year have been condensed from data kindly furnished for the use of the Medical Society of St. Louis by the Chief Signal Officer.

ST. LOUIS.

Year.	July	Aug	Sept	Oct	Mean.
1878	82.31	79.17	68.99	57.79	72.06
1877	78.4	76.0	69.8	59.6	70.95
1876	79.2	77.8	66.8	55.7	69.90
1875	78.2	73.1	67.2	54.7	68.35
1874	81.5	78.3	70.2	58.1	72.02
Mean.	79.92	76.8	68.6	55.78	70.66

LOUISVILLE.

Year.	July	Aug	Sept	Oct	Mean.
1878	81.67	78.84	68.73	57.74	71.74
1877	78.9	75.1	69.2	61.3	71.37
1876	79.2	77.6	67.5	53.6	69.47
1875	79.1	73.7	66.4	54.0	68.30
1874	80.7	79.3	72.3	57.5	72.45
Mean.	79.91	79.91	68.8[illegible]	56.33	70.66

CAIRO.

Year.	July	Aug	Sept	Oct	Mean.
1878	82.84	81.0[illegible]	69.68	59.87	73.36
1877	79.0	77.5	70.2	61.5	72.05
1876	79.9	77.5	68.6	56.1	70.52
1875	78.9	73.6	67.5	55.2	68.80
1874	81.3	78.6	71.9	58.2	72.50
Mean.	80.39	77.65	69.58	58.17	71.45

MEMPHIS.

Year.	July	Aug	Sept	Oct	Mean.
1878	83.69	82.04	71.73	61.73	74.80
1877	80.4	78.0	71.0	62.8	73.05
1876	81.3	79.1	70.0	58.5	72.22
1875	82.2	74.9	69.8	57.1	71.00
1874	82.8	82.9	73.2	60.3	74.80
Mean.	82.[illegible]	79.39	71.15	60.[illegible]	73.17

VICKSBURG.

Year.	July	Aug	Sept	Oct	Mean.
1878	83.29	82.47	75.1[illegible]	65.51	76.59
1877	82.4	81.1	74.0	66.0	75.87
1876	82.6	80.2	74.0	63.2	75.00
1875	83.5	78.3	73.4	61.9	74.27
1874	81.1	84.6	76.9	64.7	76.82
Mean.	82.5[illegible]	81.33	74.6[illegible]	64.26	75.71

GALVESTON.

Year.	July	Aug	Sept	Oct	Mean.
1878	84.81	83.90	78.6[illegible]	73.7[illegible]	80.27
1877	84.4	84.6	80.1	71.5	80.15
1876	[illegible]	83.7	79.4	71.6	79.92
1875	85.6	82.9	74.7	70.6	78.45
1874	82.5	84.4	79.5	71.8	79.55
Mean.	84.46	83.90	78.46	71.8[illegible]	79.67

NEW ORLEANS.

Year.	July	Aug	Sept	Oct	Mean.
1878	84.11	83.55	78.90	70.34	79.23
1877	83.7	83.1	78.4	70.2	78.85
1876	83.4	82.2	79.1	67.6	78.07
1875	81.8	79.3	76 6	67 3	76.25
1874	81.4	83.9	78.9	70.4	78.65
Mean.	82.88	82.41	78.38	69.17	78.21

MOBILE.

Year.	July	Aug	Sept	Oct	Mean.
1878	84 41	82.89	77.97	67.86	78.28
1877	84.8	82.0	77.6	68.1	78.12
1876	83 3	80.1	76.8	64.4	76.15
1875	83.9	78.4	75.1	62.7	75.02
1874	80 8	83.8	77.9	67.4	77.47
Mean	83.44	81.44	77.07	66.09	77.01

CHARLESTON.

Year.	July	Aug	Sept	Oct	Mean.
1878	2.94	80.60	77.22	67.00	76.94
1877	83.6	82.3	77.2	69.1	78.05
1876	83.6	82.4	77.9	62.4	76.57
1875	84.6	79.9	75.1	63.3	75.72
1874	79.3	79.1	75.8	66.7	75.22
Mean.	82.81	80.86	76.64	65.70	76.50

NORFOLK.

Year.	July	Aug	Sept	Oct	Mean.
1878	81.96	78.18	72.26	60.3	73.19
1877	79 6	77.4	68.7	62.0	71.92
1876	81.7	78.2	69 7	56.8	71.60
1875	81.2	76.1	68.7	58.3	71.07
1874	76.9	73.2	70.4	59.8	70.07
Mean.	80.27	76.62	39.95	59.45	71.57

PHILADELPHIA.

Year.	July	Aug	Sept	Oct	Mean.
1878	77.49	73.17	68.18	57.66	69.12
1877	77.8	75.5	66.8	57.4	69.37
1876	78.6	74.3	63.8	50 8	66.87
1875	74.6	72.4	64.1	53.7	66.20
1874	74 7	71.1	68.0	55.0	67.20
Mean.	76.64	73 29	66.18	54.91	67.75

By an inspection of these figures we determine the following observations:

1st. *In every one of the eleven cities, except Charleston and Philadelphia, there has been an unbroken progression of the seasonal means from 1875 to 1878.*

2d. The great seasonal mean for all the cities moves with unbroken regularity from 1875 up to 1878, which was the hottest season of the group of five years, thus:

YEARS.	1874	1875	1876	1877	1878
Great seasonal mean for 11 cities....	74.25	72.13	73.30	74.52	75.05

3d. In eight of the eleven cities, the year 1878 was the hottest of the five years. From 1875 to 1878 there has been a steady increase of temperature over the whole of the United States, south of the latitude of Philadelphia, at least, involving the in-

terior as well as the coast. Assuming, as I do, that yellow fever is the product of high temperature (as one of its main factors), we have in this very unusual heat of 1878, an explanation of the prevalence of the disease in that year on such a terrible scale. It will be seen that the year 1874 was above its mean seasonal temperature in St. Louis, Louisville, Cairo, Memphis, Vicksburg, New Orleans and Mobile. Yellow fever prevailed to some extent in Charleston, New Orleans, and other places, and terribly in Shreveport in that year. In Galveston, Charleston, Norfolk and Philadelphia, the season of 1874 was cooler than its mean.

4th. The great seasonal mean of the five valley cities is 72.33°, that of the three gulf cities, 78.29, and that for the three Atlantic cities, 71.94°. The gulf coast is therefore *habitually* hotter than the river margin up to Cairo, St. Louis, and Louisville, and this again habitually hotter than the Atlantic seaboard by .39 of a degree.

5th. The seasonal mean of 1878 for the valley cities is 73.71°, for the gulf cities, 79.26°, and for the Atlantic cities, 73.08°. In 1878, therefore, the heat was greatest throughout the season on the gulf coast, where yellow fever appeared first, and was next highest in the valley cities, where the disease prevailed extensively, being lowest on the Atlantic, where it did not prevail.

Yellow fever had been epidemic in New Orleans just 30 days before it appeared elsewhere, other points refusing to accept the disease by contagion, and being as yet unable to originate it themselves in consequence of an inadequate potency of the local causative conditions, when it broke out with an almost exact simultaneity at Vicksburg, Memphis, Grenada, Winona, Canton, Delhi, Grand Junction, Hernando, Friar's Point, Bay St. Louis, Ocean Springs, Osyka, Baton Rouge, etc., all of which places are in direct and daily communication with New Orleans by land or water, or both. The great epidemic was established in all the points where it subsequently made such havoc, in the week ending August 17th. It thus lingered, gaining strength in New Orleans, from the earlier weeks of July to the second week in August, and about the 13th of this month, with a variation of but two or three days either way, suddenly flashed out in a great many places separated by hundreds of miles from each other. Had the power of the contagion of the disease been at all marked at this period, or the outbreak acknowledged the influence of this con-

tagion as one of its prime or essential factors, yellow fever would have appeared at Vicksburg, Memphis, Grenada, and at the points named, after the usual incubative period, which, including the time necessary for sickness, death and a report of the case, is not more than eleven days; and the disease should have manifested itself, consequently, about the third week in July, instead of the third week in August. The true explanation of this is to be found in the fact that while the meteorological conditions (the terrene, such as filth, etc., being presupposed) were mature in New Orleans, early in July, they did not become mature farther north and outside of that closely built city, until four weeks at least had elapsed.

6th. It is further seen, from the figures, that yellow fever appeared and established itself in New Orleans in July, whose temperature was 84.11°, the hottest July of the series of five years.

The fever appeared and became epidemic in Vicksburg, in August, the hottest August since 1874. Temperature of week in which it appeared, 80 9°. The mean temperature of the previous four weeks was 84.9°

In Memphis, the disease was first seen and began to prevail in August, which was, as in Vicksburg, the hottest August since 1874. The temperature of the third week of this month was also 80.9°, and the mean temperature of the previous four weeks 84.9°. The conditions in Vicksburg and Memphis, as regards temperature, were identical.

In Cairo, according to Dr. Dunning's table, the first cases occurred in August, which month was hotter than any August of the five years preceding.

In Louisville, the first indigenous cases occurred in September, which month shows a temperature higher than any of the same name since 1874, except 1877.

In St. Louis, the first case occurred in August, which month was the hottest August of the five years.

In Mobile, the first cases occurred in August, the hottest month of its name since 1874, but the epidemic prevailed in October, the hottest month of its name for five years, except 1877.

In every instance, therefore, the yellow fever arose, for the localities whose meteorology has been recorded by the United States Signal Service, in the midst of very unusual, and, in three of the seven cities, unprecedented heat, so far as these records go.

SUMMARY.—Yellow fever appeared earliest in a gulf city, whose temperature is properly higher than that of the cities of the river margin, where it next appeared. The disease was not seen on the Atlantic seaboard, where the temperature is naturally lower than either on the gulf coast or banks of the Mississippi.

The disease moreover appeared in New Orleans, in the hottest month of 1878, a month which was also the hottest of the five years on record. In the other six recorded cities, we find that the month in which the disease *appeared*, was in every case but one, (Louisville), hotter than its own mean. The month *of October*, *in Louisville*, in which nearly all the *local cases occurred*, *was* hotter than its mean. It must be recollected that, while yellow fever requires a high grade of heat for its generation, and for the development of a general disposition towards a febrile condition of the economy, which enables the effluvia of putrefaction to induce the disease, the *extension of yellow fever* must be held to depend upon the development of this predisposition in persons who have neither experienced the disease nor resided long in the given locality, who are, in other words, unacclimated to yellow fever. This lack of acclimation in concurrence with a high grade of heat and of the other meteorological influences, must I think be taken as the chief cause of the rapid spread and malignant character of the disease in certain places, as in Norfolk in 1857, Memphis in 1873, and Memphis and Vicksburg in 1878.

The relative number of cases or of deaths to a given population, is not therefore an *exact* measure of the intensity of the meteorological and terrene conditions which have given birth to an epidemic, or caused the acceptance of imported contagion, but unmistakably must be held to indicate the degree of receptivity and lack of acclimation of the population which it scourges. At the same time, a continuance of the meteorological and telluric conditions at a high grade, though not necessarily at the highest, is necessary for the maintenance of the receptivity which furnishes new cases. The contagious element as given forth from the sick, is more active, I think, in the *spread* of the disease, in *September and October*, than the meteorological conditions themselves.

Again, it seems evident that some epidemics of yellow fever are far more malignant than others, and that the potency of the

materies contagiosa of the disease is much greater at certain times and certain places. Where thousands are sick in a city, or circumscribed town, not only is the air more densely charged with the contagious matter, but this principle itself would seem to be sublimated in consequence of successive transmission through the bodies of different individuals to an extraordinary degree of power. To this, in estimating the effects of the presence of a number of cases within defined limits, we must not fail to add nervous anxiety, fatigue, and moral perturbations generally, as well as the additional ingnination of the atmosphere, under the impossibility of practicing a strict hygiene, due to the presence of very unusual accumulations of filth, conditions, in general, which from the earliest period of human history to the present day, have characterized the prevalence of plagues.

The period of five years embraced in the records now under consideration, affords but a narrow scope for a comparative investigation of the influences inductive of yellow fever. We must nevertheless congratulate ourselves on the possession of these data, since they are all that can be obtained in point of time, and because, as they have been made under a common system, they are not only thoroughly reliable, but also strictly comparable with each other.

Yellow fever did not prevail, in 1878, in four cities of the eleven whose meteorolgy we are considering, viz., Galveston, Charleston, Norfolk and Philadelphia. The causes of this immunity will receive special consideration.

THE CLEAR AND FAIR DAYS.

The earth is heated proportionately to the "fairness" or transparency of the atmosphere. The coolness of night is due to the interception of the sun's rays by the earth itself; a cloudy day is cooler than a bright or fair day, in consequence of the veil of watery spherules interposed between the sun and the soil. In general, the heat of terrestrial surfaces varies as the number of fair days. Throughout the northern hemisphere, the number of fair days in the year, as a mean of long periods of time, is approximately the same, but each month varies notably in this respect. In the United States, October is our fairest month, while February is the cloudiest.

The influence of this peculiar fairness of October upon the soil heat, and consequently upon the atmospheric temperature,

explains the slowness of the diminution of the temperature of the latter part of our summers, which at times is only perceptible in the increasing coolness of the nights. From the figures of twenty-five successive years in Charleston, I find that the mean monthly fairness regulary increases from July to November, thence declining to March, again rising through the ensuing three months, to decline finally, from May to August. The following table from the Charleston records will show this.

A table showing the mean No. of fair days in each month; computed from 25 successive years:

	Jan	Feb.	Mar.	Apri	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean......	17.9	16 6	18.36	19.6	19.84	19·32	17.4	16.88	19.30	21.7	19 16	17.16

It will be observed that there are two maxima and two minima of fairness in the course of the year. The remarkable fairness of the late summer and early autumn is a phenomenon which occurs over the entire northern hemisphere, and as it exerts a most important influence upon the processes of putrefaction by the sustained temperature and high humidity associated with it, as well as upon the animal functions, it is altogether worthy of our constant and watchful observation. It is by the maintenance of the sun's influence, due to this increase of fairness in August, September and October, that the decline of temperature properly associated with the movement of the sun towards the South, and mostly due to the increasing length of the nights, is prevented. The mean daily temperature, therefore, sinks but slowly and may remain for several weeks together, almost unchanged.

This law, however, expresses only the movement of the mean of a series of years; each season exhibits a progression, in this respect, which is controlled by a variety of influences. In certain years, the fairness regularly increases, the season is prolonged, the soil temperature sinks slowly, and frost falls late. In other years, the movement of the fairness may be quite different. The soil temperature will then decline more rapidly than usual, or even suddenly, and frost, (hoar frost) will be seen early. Thus, in 1854, in Charleston, the number of fair days successively increased during the months of August, September and October, and the temperature consequently continued above its mean.

YEAR 1854.	Aug	Sept.	Oct.
Number of fair days	17	20	24
Temperature of 1854	82.11	78.03	67.32
Mean temperature of twenty-five years	80 82	76 85	66.66

While on the contrary, in 1853, the number of fair days did not increase towards the end of the season, and the temperature was lower than the mean, thus:

YEAR 1853.	Aug	Sept	Oct.
Number of fair days	15	17	17
Temperature of 1853	80.40	75 84	65.59
Mean temperature of twenty-five years	80 82	76.85	66.66

A comparison of other years, and of other meteorological elements, dependent upon the surface heat, furnish wholly similar results.

While fairness of the days favors the acquisition of heat, fairness of the nights exerts an opposite influence. The heat received by the earth during the day, is more or less completely returned at night, in proportion to the length of the days and nights respectively. Under a clear sky, the temperature of the soil, having steadily risen since sunrise, begins to decline about 3 or 4 o'clock P. M. in consequence of a preponderance of radiation from the earth towards the heavens, over that from the sun.

This decline of temperature continues until the following sunrise, but is not complete unless the night is fair. On a cloudy night the greater part of the earth's return heat is reflected from the clouds, cooling is arrested, or goes on but slowly, and no dew is precipitated. Cloudy nights are comparatively warm at all seasons, and especially oppressive in summer and early autumn. Cloudiness by night, impedes the cooling of earth, and by day diminishes the heating power of the sun. Fairness, by day, permits the sun's rays to reach the earth, and should the following night be cloudy, the heat so acquired is retained, in consequence of the impenetrability of the clouds to the heat rays emitted from the surface of the earth and terrestrial objects. The soil is therefore much warmer upon a cloudy night preceded by a fair day, than on a fair night ensuing upon a fair or cloudy day. For the production of a maximum nocturnal heat, therefore, free passage must be afforded to the sun's rays, but when the earth begins to cool in the afternoon, the sky should be veiled, and the acquired heat thus prevented from

passing off into space. Now this very conjunction of circumstances is of frequent occurrence at the level of the sea, and near the ocean or great rivers, especially in wide expanses of flat territory. It exerts a powerful influence upon the extrication of noxious effluvia from putrescent matter, greatly favors a rise in the humidity, and is usually accompanied by atmospheric stagnancy.

In all these respects, cloudiness of the nights in the hot season is a most important condition of the origin of fevers generally, of malarial fevers in rural districts, and of yellow fever in cities.

"Fairness of the days," and "fairness of nights," therefore, are phenomena of diametrically opposite significance in a meteorological point of view, and should be separately recorded as such, in all observations designed for application to epidemiological research. Unfortunately this fact, if appreciated, has not thus far been acted upon.

It is obvious, from its direct influences upon the temperature of the earth's surface, that fairness of the days is an indispensable agent of great power upon decomposition, in so far as this is promoted by heat. Let us now inquire from the records of Charleston, whether the fair days are also an indispensable agent in the origination of yellow fever.

I accordingly present the following incremental table of the fair days for all the years.

Table K, showing the increments of the fair days for thirty-eight years, and for the months of August, September and October conjointly.

Years.	No. of Days.	Hygienic Annotation.	Years.	No. of Days.	Hygienic Annotation.
1836	72	(Cholera).	1857	59	....
1856	69	Yellow Fever.	1867	58	....
1838	69	Yellow Fever.	1875	57.71	....
1840	67	Yellow Fever.	1858	57	....
1837	67	Yellow Fever.	1851	56	....
1839	66	Yellow Fever.	1846	56	....
1877	65.28	....	1868	55	....
1866	65	....	1874	54.14	....
1865	64	....	1843	54	....
1834	63	....	1841	54	....
1844	63	....	1849	53	....
1850	62	....	1845	53	....
1878	61.27	....	1852	52	....
1869	61	....	1847	51	Healthy.
1854	61	....	1853	49	Healthy.
1876	60.74	....	1842	49	Healthy.
1833	61	....	1848	43	Healthy.
1855	60	....	1832	42	Healthy.
1835	60	....			

The maxima coincide with yellow fever years, and the minima with healthy years. Cholera stands highest; we shall observe the extreme figures which this year affects, but it will not be counted with the years of "greatest epidemicity," as this expression relates exclusively to yellow fever.

I now append the complemental table of the nosological groups.

Table L, showing the progression of the means for table K. (The cholera season, 1836, is excluded):

Greatest Epidemic Years.	Least Epidemic and Sporadic Years.	Healthy Years.
Mean 62.33	Mean 59.72	Mean 56.17

The progression is regularly incremental, and confirms the indications of table K. *The fair days, therefore, are a primary agent in the production of yellow fever.*

To show that there is no possibility of doubtful significance, or of accidental arrangement of the figures, I shall present, as in the case of the "temperature," the two following pairs of tables, of many similar ones which I have in my possession, based upon varying combinations of the figures with exactly similar results in every case. In the tables that follow, August and September are considered conjointly, and so likewise are September and October. The pair already presented group the three months together.

Table M, showing the increments of the fair days for the months of August and September, conjointly; calculated for thirty-seven years:

Years.	No. of Days	Hygienic Annotation.	Years.	No. of Days	Hygienic Annotation.
1837	49	Yellow Fever.	1833	37	....
(1836)	(48)	(Cholera.)	1858	37	....
1856	46	Yellow Fever.	1845	37	....
1377	44.28	....	1849	36	....
1838	43	....	1834	36	....
1840	43	....	1850	34	....
1876	42.14	....	1867	33	....
1839	42	....	1851	33	....
1865	41	....	1853	32	....
1857	41	....	1843	32	....
1866	41	....	1842	32	....
1844	40	....	1848	31	....
1855	40	....	1852	30	....
1869	40	....	1846	30	....
1835	39	....	1874	29	....
1878	38 42	....	1841	28	....
1875	38.14	....	1832	27	Healthy.
1854	37	....	1847	24	Healthy.
18 8	37	....			

The maxima coincide with pestilential seasons, and the minima with healthy seasons. Subjoined is the corresponding table of the means.

Table N, showing the progression of the means for table M.

Greatest Epidemic Years.	Local Epidemic Years	Sporadic Years	Healthy Years.
Mean, 39.16	Mean, 37.52	Mean, 36.40	Mean, 35.00

The progression is perfectly regular. This table corroborates the previous one, although the figures are put to a very severe test, as I have already shown that August is the most unfair of all the warm months of the year. When the three months, August, September and October are considered together, this quality of August tends to weaken the figures which derive most of their strength from October.

I now present a pair of similar tables for September and October:

Table O, showing the increments of the fair days for Septem- and October conjointly, for thirty six years. (The cholera season is not counted).

Years.	No of Days.	Hygienic Annotation.	Years.	No. of Days.	Hygienic Annotation.
1840	49	Yellow Fever.	1847	41	....
1856	48	Yellow Fever.	1875	40 71	....
1838	48	Yellow Fever.	1876	40.43	....
1836	47	(Cholera.)	1844	40	....
1850	47	....	1843	40	....
1839	46	....	1877	39.14	....
1865	46	....	1858	39	....
1833	45	....	18.8	38.56	....
1837	45	....	1857	38	....
1854	44	....	1835	38	....
1834	43	....	1869	38	....
1846	43	....	1845	37	....
1866	43	....	1868	37	....
1841	43	....	1852	36	....
1867	42	....	1849	35	....
1855	42	....	1832	35	Healthy.
1851	41	....	1842	34	Healthy.
1874	41.14	....	1853	34	Healthy.
			1848	29	Healthy.

The maxima coincide with yellow fever seasons, and the minima with healthy ones. Subjoined is the companion table of the means.

Table P, showing the progression of the means for table O.

Greatest Epidemic Years.	Least Epidemic and Sporadic Years.	Healthy Years.
Mean 43.50	Mean 41.4	Mean 39.44

The progression is regular, and corroborates the indications of the previous table.

I have varied these figures of the fair days in numerous other ways, and in every instance, the results have been in perfect accordance with those I have already given. It must be regarded, therefore, as *demonstrated*, that the fair days are a primary agent in the production of yellow fever—a prime cause of the disease—without which it cannot exist, or even at its minima; while yellow fever, perforce, exists at its maxima, although under certain conditions, cholera may do so likewise.

A word or two with regard to this year of cholera (1836) may not be out of place. Not a case of yellow fever occurred in that year, notwithstanding the maximum heat and fairness of the summer. The disease broke out in July, as all choleraic diseases are apt to do, and prevailed until the October following. The mean temperature of August, September and October conjointly, of that year, was 77.17°, greater for the same three months than that of any year from 1832 to 1878 inclusively.

The mean temperature of July, August and September, the months of the prevalence of the epidemic, was 84.28°, while the great mean for the same three months, for thirty-two years previously to 1857, is only 78.29°.

The mean temperature of August and September conjointly, was 84.46°, the great mean of the same period for thirty-two years being only 76.70.

The cholera season, therefore, in Charleston, whether regarded as comprising August, September and October, or July, August and September; or only July and August, was the hottest that has ever occurred in the history of Charleston up to the present time since 1825.

From the beginning of the year, the season had been hotter than its mean, thus: Mean temperature of first six months of 1836, 63.29°; great mean (thirty-two years) of first six months, 62.91°.

The season of 1836 was also the *fairest* ever recorded, the number of fair days in August, September and October, conjointly, being 72; greater than that for any other year from 1832 to 1878 inclusively.

The month of August, 1836, was the hottest ever recorded; so also was September, but October was remarkably cool, and the epidemic came to an end early in that month. Not a case of

yellow fever preceded, accompanied or followed it, showing the antagonism of the two diseases to each other, as already insisted upon. The humidity of 1836 was remarkably low, and the rainfall very small, conditions altogether unfavorable to the existence of yellow fever.

I pass on now to a consideration of the records of the eleven cities, with reference to the epidemic in the West and South in 1878, appending below a table of the number of fair days in each of the four summer months of the five years, 1874 to 1878 inclusively, and for each of the eleven cities, with the monthly and seasonal means and totals.

ST. LOUIS.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	18.63	24.14	25.42	24.57	92.76
1877	22.00	24.10	20.61	17.53	84.24
1876	24.00	26.58	18.71	23.28	92.57
1875	15.29	28.00	26.29	25.42	95.00
1874	21.00	23.29	21.57	23.00	88.86
Mean	20.18	25.22	22.52	22.74	91.66

LOUISVILLE.

Year.	July.	Aug.	Sept.	Oct.	Total.
18[illegible]	23.71	23.71	21.43	21.43	90.29
1877	19.57	24.57	17.71	18.42	80.17
1876	26.99	20.43	21.86	22.38	91.66
1875	8.43	21.14	19.43	23.14	72.14
1874	23.57	20.14	22.29	23.00	89.00
Mean	20.47	[illegible]	[illegible]	21.67	84.65

CAIRO.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	22.14	22.57	24.43	24.14	93.28
1877	19.00	23.14	17.85	21.28	81.27
1876	25.14	19.85	23.43	21.14	89.56
1875	14.57	25.14	21.14	24.42	85.27
1874	22.14	18.57	15.56	21.57	77.84
Mean	20.69	21.85	20.48	22.51	85.44

MEMPHIS.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	22.27	23.57	18.14	16.00	79.98
1877	23.00	21.86	17.72	19.42	82.00
1876	23.85	20.43	22.43	23.14	89.85
1875	19.00	20.14	20.86	25.43	85.43
1874	28.43	[illegible]5.00	21.[illegible]0	28.00	102.43
Mean	23.31	[illegible]	20.03	22.49	87.94

VICKSBURG.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	26.00	24.57	23.00	22.71	96.28
1877	22.00	28.00	16.51	19.85	86.36
1876	16.14	21.57	25.00	25.71	88.42
1875	22.38	[illegible]2.00	17.00	23.57	84.95
1874	25.86	25.43	16.57	27.00	94.86
Mean	22.48	24.31	19.61	[illegible]	[illegible]

GALVESTON.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	25.15	22.14	[illegible]2.00	22.86	9[illegible].15
1877	23.00	30.00	24.00	19.57	96.57
1876	24.28	24.85	26.43	25.71	101.27
1875	[illegible]8.57	23.00	22.28	26.42	90.27
1874	24.00	24.14	17.28	27.57	92.99
Mean	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NEW ORLEANS.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	24.00	25.57	21.00	23.86	94.43
1877	20.00	24.29	16.17	15.29	75.75
1876	19.14	23.57	27.00	28.28	97.99
1875	24.71	19.00	17.87	23.28	84.86
1874	24.28	26.28	15.71	28.00	94.27
Mean	24.42	23.74	19.55	23.74	89.46

MOBILE.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	16.85	17.86	16.71	22.85	74.27
1877	28.00	21.29	12.28	16.43	78.00
1876	18.14	21.14	26.71	25.14	91.13
1875	27.00	15.14	19.00	24.43	85.57
1874	21.28	[illegible]3.0	23.00	29.57	96.85
Mean	22.25	19.69	19.51	23.68	8[illegible].16

CHARLESTON.

Year	July.	Aug.	Sept.	Oct.	Total.
1878	24.42	22.71	15.71	22.85	85.69
1877	24.06	26.14	18.14	21.00	89.28
1876	25.71	20.71	21.43	19.00	86.85
1875	26.57	17.00	21.14	19.57	84.28
1874	10.86	13.00	16.00	25.14	65.00
Mean	23.31	19.91	18.48	21.51	82.22

NORFOLK.

Year.	July.	Aug	Sept.	Oct.	Total.
1878	18.85	14.38	15.71	21.71	70.55
1877	15.85	20.43	14.42	22.57	73.27
1876	20.5[illegible]	20.7[illegible]	14.71	19.71	75.69
1875	17.57	9.57	22.10	2[illegible].14	71.28
1874	24.14	22.00	23.14	26.14	95.42
Mean	19.39	17.41	18.00	22.45	77.24

PHILADELPHIA.

Year.	July.	Aug	Sept	Oct.	Total.
1878	21.71	18.38	19.71	23.56	83.36
1877	22.85	19.2[illegible]	[illegible]3.72	18.28	64.13
1876	29.00	22.28	15.71	24.57	91.56
1875	22.14	13.00	24.28	21.85	81.27
1874	21.29	23.71	17.85	22.71	85.56
Mean	22.4[illegible]	19.33	18.25	22.19	81.18

We find in the first place, that the mean of the great seasonal means for the three Atlantic cities is 80.21 days; that for the three gulf cities, 89.75 days, and for the five valley cities, 87.77. As the openness of the sky, whereby the sun's light and heat are allowed to fall upon the earth's surface, is a prime factor in the exaltation of the temperature, this result, being in all respects the same as was observed for the temperature, was to have been anticipated. We have found that the Atlantic cities are, as a rule, cooler than those of the Mississippi Valley; they are also less fair; and that the valley cities are cooler than those of the gulf, and they are, as we see, less fair also. The gulf cities are the hottest of the series, and their summers are also the fairest. These results indicate, moreover, that in consequence of the influence of fairness of the sky upon the temperature, the gulf cities should be more subject to yellow fever than the cities of the river margin, and these again than the cities of the Altantic coast. These influences of fairness and heat, also explain the well-known northwardly trend of the isothermal lines drawn from points on the Atlantic coast westwardly, as they approach and cross the Vailey of the Mississippi. (See chart of Isothermal lines in North America, as determined by the Smithsonian Institution, Patent Office report for year 1856). In commenting upon th's matter, Prof. Joseph Henry remarks: "These lines, at a glance, exhibit remarkable curvatures, particularly in the western portion of the United States, indicating a great increase of

temperature in this region beyond that of the eastern and middle portion." * * * "The line of 80° commences near Charleston, S. C., and extends rapidly upward through the Valley of the Mississippi, thereby indicating that the temperature of summer in the interior, along this parallel, is much higher than upon the sea board. The western portion of this curve also exhibits great intensity of summer heat in the mountain system." (pp. 483 and 485 loc., cit.) New Orleans has the summer temperature (line of 82.5°) of Key West.

An inspection of the means for each of the five years and for all of the Valley cities in which yellow fever prevailed in 1878, gives us the following:

	1878	1877	1876	1875	1874	Mean.
Valley Cities....................	93.50	82 81	9[illegible].41	84.5[illegible]	9[illegible].60	8[illegible] 77

From which it appears that the year 1878, as the average of these five cities was the fairest since 1874, and fairer than the mean of all the years. While on the other hand similar figures for the three Atlantic cities in which yellow fever *did not prevail* in 1878 are as follows:

	1878	1877	1876	1875	1874	Mean.
Atlantic Cities...................... ..	79.86	7[illegible].53	84 70	78.94	81.99	8[illegible].20

Showing that in these cities, exempt from yellow fever, the year 1878, as *mean of the three cities*, was less fair than the average.

In New Orleans the seasonal total of 1878 was 94.43 days, considerably greater than the means for five years, viz., 89.46 days.

In Mobile, the seasonal total of fair days is 74.27, *less* than its mean of five years (85 16). It must be recollected that yellow fever did not prevail in Mobile until late in the season, and then only to a very limited extent.

Let us now consider the months of 1878, in which the first indigenous cases of yellow fever occurred in the seven cities where the disease prevailed more or less extensively.

In St. Louis the first case occurred very late in August, with a fairness of 24.14 days, less than the mean of five years for that

month; but the next cases occurred in September, considerably fairer (25.42 days) than its mean, 22.52.

In Louisville the first local case was in September (16th) and we find that this month was fairer (21.43 days) than its mean, (20.54.)

In Cairo, the first cases also occurred in September, which was the fairest month (24.43 days) of its name *for five years*, the mean being 20.48.

In Memphis the first local case occurred in August (13th), which month we find to be the fairest of its name (23.57 days), since 1874, and to have been fairer than its mean for the five years, viz., 22.20.

In Vicksburg, the first cases appeared in August (about the 11th or 13th) and we find this month to have been fairer than its mean; mean of 1878, 24.57 days, and of the same month for the five years, 24.31 days.

In New Orleans the disease appeared in July, which month we find to have been fairer than its mean; mean of July, 1878, 24.00 days; mean of five years for the same month, 22.42 days.

In Mobile the first case occurred on the 15th of August, and we find this month to have been less fair than its mean, so also for the month of September and October, both of which were less fair than their means. Consequently, although the disease appeared, it never made progress, giving a total of only fifty to seventy deaths for the entire season, notwithstanding the proximity of the city to New Orleans, and the inevitable introduction of cases infected in that city, throughout the summer.

THE RAINFALL AND INUNDATIONS.

The temperature of the earth's surface and the activity of all processes of a chemical character which take place upon it, as well as the temperature and humidity of the strata of the atmosphere in contact with it, are more directly affected by the water which is precipitated from the atmosphere under given conditions in the form of hail, snow and rain, than by any other meteorological element, except the cloudiness of the sky.

Snow, which is a poor radiator, and worse conductor, preserves the earth's heat by interposing its mass of interlocked crystals enclosing air among their spiculæ, between the earth and the colder atmosphere above. Vegetation is thus protected from extreme cold, being seldom subjected, under such circum-

stances, to a temperature lower than 32° F., which the cereals and many other plants important to mankind are able to withstand.

When the surface is encrusted in ice, as happens when freezing weather comes on suddenly after a rain or a thaw, the soil which lies beneath the frozen crust is protected, in a measure, from further reduction of temperature unless the weather is persistently cold. So, likewise, by a casing of ice, due to the freezing of sleet, the buds, leaves and branches of plants are similarly protected, to some degree. Such a coating, however, as ice is a far better conductor of heat than snow, is by no means so effectual in preventing an injurious reduction of temperature as snow itself, which, in a loose form, is almost as good a non conductor of heat as a mass of feathers.

When snow or ice melts upon the surface, flowing away over it, or slowly sinking through it, as the temperature of melting ice is 32°, the surface is necessarily reduced to that temperature, and if of a porous nature, to a depth proportionate to its saturation with water.

Rain may be warmer or colder then the surface. We often see a covering of snow quickly dissipated by a warm rain, while on the other hand, as the temperature of the surface is nearly always greater than that of rain, and this absolutely so in the summer months, the surface heat is continually reduced by frequent and copious showers. If the quantity of rain be considerable, the effect upon the surface temperature may be very marked, since water takes away a great amount of heat in the latent form; and this diminution of soil heat, moreover, may be maintained for a long period of time, by frequently repeated falls of heavy rain. After such a fall of rain, if winds prevail which are not excessively humid, so much heat is removed, both by aerial convection and the process of evaporation, that the temperature of the soil may decline considerably, and fail to rise again, or notably, until another similar fall of rain. In this way a low grade of soil temperature, and of all things in contact with the soil, may be maintained for weeks, or even during entire seasons. Seasons, therefore, in which there is the greatest fairness and least rainfall are necessarily the hottest, and those in which the sky is generally cloudy, and much rain falls frequently, accompanied by wind, as in thunderstorms, are of the lowest temperature. The entire effect is due, not so much to the

absolute quantity of rain which falls, as to the number of days upon which rain falls, and the number of such days must be considerably above the mean to produce the soil-temperature spoken of.

Conversely, when rain is followed by calms or humid winds, and by bright sunshine, as the humidity of the air is thus exalted, cooling of the surface to any notable degree does not take place. This absence of the refrigerating effect of rain is particularly obvious when to the above conditions that of cloudiness of the night is superadded.

The temperature of the soil is similarly affected, and, indeed, controlled by floods, and inundations. If the inundation, as in the case of tides, be frequent, the surface is maintained at a temperature very nearly that of the water which flows over it and saturates it; hence the coolness of the sands of the sea beach, and of the mud of ponds subject to tidal overflow.

The sprinkling of streets is in imitation both of the fall of rain and inundation. Within certain limits, the practice is conducive to comfort and perhaps to health, by cooling the surface and keeping down organic and mineral dust. The soil can be cooled by this process only when the air is not very humid, or when winds prevail. On the contrary, if the atmosphere is at rest and contains much vapor, no such effect is produced; while, if the sun shines at the same time, for reasons to be briefly set forth in connection with a consideration of the humidity of the air, the temperature of the soil may even be increased by this procedure.

The effects of water, as precipitated from the atmosphere, or furnished by inundations and similar processes, upon the decomposition of putrefiable matter, whether spread upon and impacted in the surface, collected in heaps, enclosed in pits underground, or lying in the form of an accumulated deposit beneath stagnant water, demands the closest attention of the sanitarian. Few subjects have a more directly practical bearing. Water is requisite for all putrefactive processes. When absent or deficient in quantity, as in such degrees of dessication as are possible under natural conditions, putrefaction is as perfectly arrested, or nearly so, as by freezing. When added to organic matter in very great quantity, although the decompositive process is not thereby rendered less certain in due course of time, it is nevertheless held in abeyance by the reduction of temperature which almost invaria-

bly attends very great accessions of moisture, whether due to repeated falls of rain or to persistent or regularly intermittent inundation. But when water is supplied in moderate quantity and at intervals sufficiently prolonged to admit of the primary depression of temperature, which its addition causes, becoming neutralized by the heat-forming powers of fermentation, by direct insolation, or the contact of warm air, conditions are furnished which are most suitable to the promotion of the putrefactive process. *Putrefaction, therefore, as occurring in a sanitary sense,* over the street area, and in the agminations of putrescent matters of cities, *will not vary with the rainfall, but will be most active with a rainfall a little less than the mean,* while strictly held in check by great or total deficiencies of rain, and no less distinctly, though to a less extent, by the constant accession of rain. This proposition is continually illustrated in the history of epidemics, and dominates over most of the conditions of putrefaction. It will be fully illustrated in the record which I shall present further on, in which the existence of yellow fever of the highest intensity will be found to be associated with a rainfall which is somewhat less than the mean of that proper to the month or season in which the disease appears, while the driest seasons are necessarily healthy, and those of very great and extreme rainfall, for various reasons, are productive of sickness, but not of any extensive epidemics of yellow fever.

Drought prevents putrefaction and the extrication of effluvia; excessive rains cool the general organic surface and special collections of filth, and thereby prevent putrefaction, and at the same time wash away a vast quantity of organic matter. Heavy rains still further purify the air by bringing down the dust-like organic matter it contains, and freeing it, perhaps, of soluble gases. Rain water always contains ammonia, and nitric acid in combination with it, if resulting from thunderstorms, and it has been shown by Schiefferdecker, at Konigsberg, that the ozonicity of the air on rainy days is far greater than usual.

Uniform dryness of a season is therefore, in general, conducive to health, and especially forbids the appearance of a disease like yellow fever, which owes its origin to the activity of the processes of putrefaction, although it may be associated with the existence of cholera, which is very probably due to drinking water drawn from wells or other sources, naturally, or by defective care, impregnated with decomposing organic matter.

On the other hand, constant moisture of the soil, as maintained by frequent light showers, followed by fair weather, is most conducive towards disease, and to yellow fever in particular; while uniform and excessive falls of rain are conditions of health, always provided drainage be adequate.

Something remains to be said with regard to the influence of stagnant water upon the putrefaction of organic matter which is accumulated beneath it, or dispersed in a gross or flocculent form through it. These are the conditions of mill-ponds, shallow lakes, land-locked harbors, and unused channels of rivers through which there is little or no current, within the proper area of cities, or contiguous to them. Such bodies of water are necessarily at the lowest levels, and consequently receive the common sewerage as well as the washings of the surface, as a rule. During the winter, when the water is too cold to admit of the putrefaction of the mud at the bottom or of the matters in suspension, such waters are clear, and their presence is wholly unobjectionable. In the warm season, however, this is by no means so. The organic matter enters into decomposition at a much earlier date than would be supposed from the temperature of the water, which is still transparent. The water becomes quickly warmed by a special and interesting mechanism, and remains heated, thus continuing the processes to which its temperature administers, without interruption, while on the solid surfaces of the earth these processes are often intermitted and even brought to a final arrest by conditions which have but slight influence, or none at all, upon the temperature of large masses of water already heated. The earth's surface, over-heated by day, tends to cool at night; a large pond or shallow bayou full of muddy water, once heated, does not cool perceptibly in any one night, for radiation from its bottom is cut off by the overlying water itself. Water which holds organic matter in a flocculent form is nevertheless transparent, although in bulk we call it turbid, and permits the rays of the sun to pass through it with readiness. Early in April such collections of water are thoroughly transparent, even to the depth of several feet, and the sun's rays pass readily to the bottom to be absorbed by the dark organic matter which is accumulated there. A return radiation through the superincumbent fluid, although transparent, is not possible, for the heat rays are of too low an intensity to pass through transparent media through which the more quickly vibrating rays of

the sun pass readily. The bottom thus becomes heated, and the superjacent water, acquiring heat from it, as the water in a pot does from its bottom, rises in temperature by degrees, until it reaches a point at which putrefaction is possible or rapid, in the material lying beneath it. This process penetrates deeper and deeper, and by the mechanical action of the gases which it generates, stirs up the layers of matter, and projects its particles into the water, with which they become commingled, rendering it, as we say, turbid. This turbidity, however, is not complete, for each minute particle itself serves as a point of condensation for the rays of the sun and thus continues the process, so that the general aqueous collection rises still further in temperature, to even 90° or 100°, a point at which all kinds of putrefaction are at a very high grade of activity. It is curious to note how early in the season, shallow, stagnant masses of water of this kind, overlying blackish organic deposits, become warmed. This is effected by a principle just the obverse of that involved in the manufacture of ice by the Hindoos; the organic, dark-colored bottom, is in a condition strictly similar to that of the soil of a hot-bed; the glass, in this case transparent like the water, preventing the return of the heat acquired by insolation, and effecting a general rise of temperature of very rapid progress, by this retention.

Dark organic matter, therefore, covered by a layer of water varying from 6 inches to a few feet in depth, such as are found in ponds, temporary collections of water in places below the levels of drainage, in the open drains of some cities, and in swampy regions all over the world, must be regarded as highly effective in concentrating the heat of the sun. The condition is one of the widest occurrence, and of the greatest importance with reference to the causation of malarial and miasmatic diseases, as it is the usual one for the putrefaction of organic debris washed together, or falling into water. A mass of water of this kind, such as Bayou Gayoso, of Memphis, is a a source of miasmatic effluvia both during the day and night throughout the warm season, not subject to the influences which affect the surfaces of streets or yards, or small collections of filth, on account of its great mass, while the vapor emitted from its heated surface constantly bears away with it emanations of the most noxious character.

[While I write, July 26th, 1879, yellow fever exists in Mem-

phis, having appeared on the 10th inst. There have been one hundred and twenty cases to date, thirty-eight deaths, and the disease is steadily spreading. No yellow fever now exists in any other city of the union. In connection with the subject under discussion, I insert the following local report relating to the condition of Bayou Gayoso. It is almost inconceivable that notwithstanding the fearful and ever memorable experience of 1878, this most dangerous body of foul water has been allowed to remain in the same condition it was in last year, in consequence of the lamentable prevalence of doctrines of exclusive contagion and importation, whose fatal effect is to encourage apathy and prevent sustained attempts directed towards the maintenance of those sanitary conditions which experience and indeed *mere common sense* have long since determined to be absolutely indispensable to the conservation of health. In Memphis we must look to the condition of the streets, privies and cow-yards, to the overflowed places, and its notorious bayou. This is altogether more likely to prove useful than determining whether Mrs. Mulbrandon caught her sickness out of a trunk or not. We can readily postpone such discussions until Memphis is clean, her privies abolished, her cow-yards forbidden, her low areas drained, and her bayou flooded through with the strong current of the Mississippi. I insert the following article from a public print:

WHERE MEMPHIS' MALARIA CAME FROM.

Gen. Greene, Chairman of the Committee on the Sanitary Condition of the Bayou Gayoso, made the following report, which, on motion, was adopted. The necessary appropriation was made, and the committee was empowered to act at once:

July 15th, 1879.

JAMES D. PRESTIDGE, ESQ., PRESIDENT OF THE AUXILIARY SANITARY ASSOCIATION:

SIR:—The committee to whom was referred the consideration of ways and means for improving the sanitary condition of Bayou Gayoso, beg to report that they are carefully studying the question, with a view to presenting matured plans which they hope, when completed, will meet your approval, and will invite a general public interest in this subject, of vital importance to the health of the city. But, considering the magnitude of the work and the time required for its completion, the committee have thought it expedient, in view of the urgency of the situation, as it now exists, to recommend a simple and expeditious remedy, which will for the time answer the purposes the

Association have in contemplation. Without, therefore, interrupting the study of the larger object for which your committee was raised, they beg to submit the following plan, which, in their judgment, will, if properly carried out, temporarily abate the many nuisances which to-day abound in the bayou. For more than a fortnight no fresh water has passed into the bayou, and the supply remaining in it is insufficient to keep the stream in motion. Stagnant and offensive pools are to be found in many places in its bed, varying from one to five feet in depth, which are the receptacles for dead animals, exhaling noxious, poisonous vapor, hurtful to the public health, not to mention the privies, stables and private sewers which discharge their deadly contents into it. In seeking a temporary remedy for these evils, your committee have found that the elevation of the bayou at its mouth is 78.6, and at Elliott street 110, thus giving a fall from that street to the point it debouches of 31.4. The bayou, just below the bridge on Elliott street, is about fifty feet wide, and fifteen feet from bank to bed. At this point your committee recommend that a dam should be constructed which will convert all that part of the bayou lying south of Elliott street into a basin or reservoir, which shall be supplied with a quantity of water, which, when suddenly discharged, shall be great enough to flush and clear the bayou from Elliott street to its mouth. To obtain the necessary supply of water they recommend that two of the water company's plugs be opened and the water discharged into the basin. One plug will theoretically discharge 500 gallons per minute, but assuming, by reason of elevation, use, evaporation and soakage, the supply to be equal to 300 gallons per minute, one plug will discharge 18,000 gallons per hour or 432,000 gallons per day. In two days the basin would receive from two plugs 1,728,000 gallons, equal to 230,400 cubic feet of water, weighing 14,400,000 pounds. Having confined this mass of water, the dam should be exploded, thus allowing the mass to sweep through the bayou to its mouth. It is allowed that the momentum of the volume will be diminished by the sinuosities of the bayou and projecting angles, but it is believed that these obstacles will not materially affect the general result. The cost of the work is estimated at $75, including the purchase of wheelbarrows, picks, powder, etc., the water company having, with the most commendable public spirit, offered to supply the water for the experiment free of charge. If the plan of your committee results successfully, they would recommend that a dam with sluice gates, or some other practicable means, be adopted and used, until the committee shall have completed their labor and presented such plans of converting the bayou into a health preserving stream of pure, running water.

COLTON GREENE, Chairman.
W. E. BOGGS,
J. R. GOODWIN.]

When rain falls in very great abundance in a short period of time, as in storms, its effect upon the public health are apt to be altogether different from that of an excessive rainfall distributed over longer periods of time. When the distribution is regular, the earth is cooled, and the effluvia of putrefaction swept away by the accompanying winds, so that the general effect is highly beneficial. Scarcely any amount of rainfall is capable of an injurious influence directly, in a city built upon an undulating surface, with well paved streets, and good natural and effective artificial drainage. But the case is far otherwise when the prodigious falls of rain which occasionally happen, occur in cities built upon a flat surface, naturally and artificially devoid of drainage. Here it collects in slight depressions of the surface, and being full of organic matter, soon putrefies in the heat of the first fair days, loading the atmosphere with noxious emanations, and with vapor of water.

In such unusual rains, moreover, cellars are flooded, and as these excavations cannot be drained, nor indeed emptied when full, in cities but a few feet above the level of the water courses or ocean upon which they are situated, the foul water which fills them, and which is still further contaminated, as I have often seen, by admixture with grain, wheat, flour, and a variety of substances capable of putrefaction commonly stored in cellars, soon putrefies, or if bailed or pumped out, leaves a pulpy mass of sediment on the bottom of the cellar to putrefy. In a city like Charleston, where such storms are not unusual, and where the conditions are such as I have described, overflow of the cellars is well known to be exceedingly dangerous to the public health. I have seen numerous instances in my personal experience of cases of yellow fever produced in this way, notably one of the the first cases in my own practice of the epidemic of 1858, which occurred in a house on the west side of Church street, and adjoining St. Philip's churchyard on the north, used as a bakery. The cellar was filled with barrels of flour, which burst when the rain water poured in. The stench produced by its putrefaction was fearful, and within a week or ten days after the overflow and pumping out of the water, several cases of yellow fever occurred in this house. Curiously enough, the first case was of distinctly remittent character, while the rest were of the usual continuous type, several of them with black vomit. The same disastrous effects of inundation of the cellars, partly by unusually heavy

and continuous rains, and partly by overflow of the tides, were observed in 1854. The fever broke out late in August, and on the 6th, 7th and 8th of September, a very violent storm prevailed. All the low areas as well as the cellars, incapable of drainage, were flooded, and the fever, though checked for a few days by the general declension of temperature, became suddenly epidemic on an almost unprecedented scale, within ten days afterwards. These matters are thoroughly well understood in Charleston, and the condition of all low areas and cellars is carefully watched by the health authorities. I quote a few lines from the report of Dr. J. Somers Buist, City Physician, to the Chief of the Health Department, Dr. Geo. S. Pelzer, on this important subject. Under the date of April 15th, 1868, this gentleman writes as follows:

"It is particularly to the existence of low, damp, and undrained localities, that I would call special attention.

1st. Among these is the section extending from Cannon street on the north, to Radcliffe on the south, and bounded by Coming on the east and Rutledge on the west. It is here that after each heavy fall of rain the water accumulates, and not having sufficient drainage, remains, saturating the earth, frequently for days, subject to the influence of the hot summer suns, remaining stagnant, or else evaporating so quickly as to produce very serious effects, added to which, there being no outlet to that in yards and cellars, it frequently remains unattended to, until compelled by the report of *nuisance,* steps are taken to remedy the evil. Though there is sewerage in this vicinity, yet from the nature of the locality, and the general character of the inhabitants, it seems that it is not sufficient.

2d. The section known as the Palmetto street lots, and Lucas street shanties, built upon stilts, the surface of the yards below that of the streets, when upon every spring tide they are submerged, no outlet being secured, no drainage executed, and inhabited by large numbers of negroes and poor whites, huddled together and living in filth. The water accumulates in large quantities, and the earth is in a perpetual state of saturation.

3d. Gadsden street and its vicinity are very nearly of the same class, producing the same injurious effects. * * * * * * The strict enforcement of the law, requiring the proper drainage and filling of lots, the elevation of open lots above

streets, with proper vent to the accumulated water, not to speak of the initiation of a system of paving the streets, are the means which suggest themselves as proper and expedient to correct these evils."

Whenever inundation has occurred, whether by rain, tidal or river overflow, no injurious effects can arise, as long as the water remains cool. It is only during the process of drying up, that such collections of foul water emit steams laden with noxious odors. Especially is this the case, when evaporation has reduced the contents of low areas or of cellars to a muddy consistence. The superabundance of water being abstracted, and the temperature of the pasty matter having been raised to its maximum by the action of the sun, putrefaction advances in full rapidity. The literature of the etiology of fever, abounds with illustrations of these facts. It is not while an inundation lasts, or while ponds are full of water, that their worst effects are observable in the production of fever, but while they are in the latter stages of exsiccation. Large shallow masses of foul water, however, which by long exposure to heat acquire a high temperature, are a source of noxious effluvia at all times; though of course, these would be still more abundantly extricated, and in a more detrimental mode of chemical composition due to partial inadequacy of water, should such collections be reduced to a mud-like consistence by evaporation.

The following table shows the mean rainfall in inches, for each month in the city of Charleston, as computed from a series of twenty-six years.

	Jan	Feb.	M'ch	April	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.
Mean......	2.32	2.04	3.98	1.41	3.96	3.59	5.89	6.56	4.89	2.59	1.60	2.56

The greatest rainfall habitually occurs in August, and the least in April. As much rain falls in the two months, August and September, conjointly, as in any other *three* months taken together.

The first two months of the yellow fever season are consequently characterized by a maximum degree of rainfall; the rainfall of October is the least of the three months. This is in accordance with the movement of the fairness of the days, which we have seen to be in exactly reverse order. It must not be supposed, however, that because the rainfall of September is twice as great as that of October, and that of August about two

and a half times as great, that the fairness of August and September is diminished in proportion. The greater rainfall is not due to a greater number of rainy days, but to heavier showers. This will be seen from the following table, which shows the mean number of inches of rain which falls upon *one rainy day*, for each month, from the records of twenty-six years:

	Jan.	Feb	M'ch	April	May	June	July	Aug	Sept.	Oct.	Nov	Dec.
Mean	0.317	0.3[illegible]	0.51[illegible]	0.[illegible]6	0.528	0.43	0 47	0.53[illegible]	0.597	0.51[illegible]	0.27[illegible]	0.290

Upon *one rainy day*, on an average, most rain falls in September; nearly six-tenths of an inch, a very copious fall. In August, 0.537, more than half an inch; while in April, we have but 0.262, about half as much in a day as in August. Conjointly, therefore, August, September, and October, are characterized by a greater *intensity* of rainfall than any other period of three months in the year; we have already seen that in August and September conjointly, as much rain falls as in any other three months. An essential character of these two months is found in this maximum intensity as well as absolute quantity of their rainfall.

Let us now examine the quantity of rain with reference to the prevalence of yellow fever in the follow table:

Table Q, showing the rainfall, in inches, for all the years since 1841, twenty-seven in number, for which the record can be obtained, and for the months of August, September, and October, conjointly—arranged incrementally.

Years.	Rainfall.	Deaths by Yellow Fever.	Years.	Rainfall.	Deaths by Yellow Fever.
1876	30.68	30	1846	13.71	....
1878	25·72	....	1858	13.59	716
1841	23.38	Sporadic.	1877	13.38	....
18[illegible]3	20.39	3	1842	13.14	....
1867	20.69	....	1866	11.84	1
1848	18.26	....	1854	11.62	627
1852	17.64	310	1865	10.32	....
1845	17.20	....	1869	9.82	....
1853	17.07	....	1875	9.39	....
1868	15.84	....	1856	8.99	212
1874	15.57	40	1855	6.83	....
1849	15.34	125	1851	6.76	....
1847	14.21	...	1859	6.31	....
1844	13.86	....			

The mean of this table is 18.45 inches; that by the table of monthly rainfall for the year, from a series of years prior to

1876, whose absolutely unparalleled figure was consequently not included, is 14.04, for these three months conjointly.

It will observed that the three minima are healthy years; this is in accordance with theoretical considerations.

Four great epidemic years are included in this table, viz.: 1852, 1858, 1854 and 1856, the mean of whose rainfall is 12.96, say thirteen inches of rain. This is two inches less than the mean of the table—and is quite in accordance with the statement that a mean rainfall, or one a little less than the mean, is most promotive of putrefaction, and should, therefore, be associated with epidemics of magnitude, provided other meteorological conditions concur. It must be observed, that a great epidemic may occur in Charleston with a seasonal rainfall of 9 inches (1856) up to 17.64 inches, (1852). It is doubtful whether yellow fever can make great progress with a less rainfall than seven inches, unless ponds or bayous exist near by, which are independent of the rainfall as a source of pyretogenous effluvia, such as the mill-ponds and fish-ponds of Charleston, and the bayous of Memphis and New Orleans, which traverse the heart of the city in various directions. The general influence of rain in causing yellow fever, is observed in the fact, that counting upward from the middle or mean point of the table, viz., 1847, we have six yellow fever years, while in the reverse direction we count but four. The rainfall of the most disastrous year in the annals of Charleston, viz., 1858, was 13.59, only 0.40 less than the great annual mean.

The mean rainfall of all the healthy years is 13.70, and of all the yellow fever years 17.33, showing the injurious influence of unusual rainfall during these months.

The rainfall of 1876 was unprecedented: For July it was *ten* times as great as for the previous year, (11.23 inches); in August it was a little less than its mean, with a high temperature and low barometer; in September, in conjunction with an exaggerated temperature, the rainfall was also unprecedented, viz., 11.26 inches, the mean being 4.89; in October there was a great excess of rainfall—more than four times the average of corresponding months of the three preceding years, viz., 14.32, and five and a half greater than its serial mean (2.59)—*two thirds* of this rainfall fell in twenty four hours, a fact that directly points to inundation by rain flooding of low areas, and filling up of cellars. It is to these conditions, that the existence of the limited fever of 1874 must be attributed, as it prevailed altogether in September and Oc-

tober, the two months of this unparalleled rainfall. We note that the maximum number of deaths occurred in October, the month of rain flooding, with but two deaths in November, whose rainfall was 1.35 inches, considerably less than its mean, (1.60) The conditions were such as are not attended by a great epidemic. The disease, though caused by stagnation of rain-inundations in cellars and low places, was nevertheless held in check by the copious and continued rains of September, in which month there were twelve days upon which rain fell, a very unusual figure. Had the floods which fell in one day of October, done so, late in August or early in September, as in 1854, and been followed by constantly fair days, a disastrous epidemic would have prevailed. These conditions of yellow fever occurred too late for the disease to spread to any extent. This is illustrated in the following table.

A table showing that the greatest mortality by yellow fever of any month during its prevalence, coincides with the greatest rainfall of the months during which the disease prevails.

Year	Month.	Rainfall.	Mortality.	Remarks.
1876	August.	5.10	...	Two-thirds of the whole amount of the rain for October fell in one day.
	September	11.26	10	
	October.	14.32	18	
	November	1.35	2	
18 8	August	5.80	111	
	September	7.02	417	
	October	0.77	165	
18 6	August.	5.86	17	Up to August 28th, only 0.44 inches had fallen; but, upon the 28th, 29th, 30th and 31st, 5.22 inches fell, which must be regarded as falling in September.
	September	1.32	95	
	October.	1.81	83	
1854	August.	1.56	58	Almost the whole rain of the month fell in a storm upon the 6th, 7th and 8th.
	September	8.73	401	
	October.	1.2[illegible]	15[illegible]	

Heavy rains occurring during an epidemic of yellow fever, and giving place to light showers and hot sunshine, always produce an exaggeration of the prevailing disease. Thus in September, 1854, a memorable storm occurred in the first week of the month; a great portion of the surface of the city was overflowed by the sea; cellars and low places were inundated. The rest of the month was slightly showery. The fever which had begun in August, became at once extremely malignant a few days after this storm, with a greater number of deaths than any previous season.

It is proper to remark in this place, that the records of the pluviometer are less distinctly significant than that of any other meteoro-

logical instrument. This is evident upon reflection. By the thermometer, hygrometer, barometer and anemometer (to a very considerable extent), and by close estimation of the aspect of the sky and notation of thunderstorms, the elemental variations are noted as they actually occur, not only at the office where the observations are taken, but everywhere in the vicinity. With the raingauge, on the other hand, the case is altogether different. At the office, the number of inches falling upon the *plane surface* of the instrument is noted, and this is only a very crude approximation to the condition which prevails on the surface of the earth, which is *never* a plane surface. The depth of a fall of snow or sleet can be truly noted at a central office, for these matters remain mostly where they fall unless banked together by the wind. Rain, on the other hand, being in a fluid form, at once seeks the lowest levels, so that while the raingauge declares that a certain depth of rain has fallen, within a very short period, almost before the shower is over, the greater part of the surface is freed from water, which has passed off into the drains or into lower areas. It thus happens, that local inundations of any depth may occur from rainfalls of very variable degrees as recorded by the raingauge, the matter being controlled entirely by the drainage of the locality and its variations as to level. It is obvious, therefore, that all the phenomena of the flooding of undrained places of low level, with their attendant consequences, may be observed with very different degrees of rainfall, as they depend not merely upon the quantity of the rainfall, but very largely upon the amount that falls in a given time. The record is not, therefore, like the thermometer and hygrometer, in direct relation with the natural phenomena, and can never furnish data capable of subserving a very rigid comparison.

I now present a table showing the monthly and seasonal fall of rain for each of the five years—1874 to 1878,—and for each of the eleven cities, with monthly and seasonal means:

ST. LOUIS.						LOUISVILLE.					
Year.	July.	Aug.	Sept.	Oct.	Total.	Year.	July.	Aug.	Sept.	Oct.	Total.
1878	3.93	4.86	3.56	3.13	15.48	1878	4.00	4.3[illegible]	2.54	3.81	14.68
1877	2.88	2.61	3.56	4.92	13.97	1877	4.19	2.[illegible]	3.02	1.81	11.72
1876	5.90	5.03	7.63	1.66	20.22	1876	3.61	4.[illegible]9	2.66	7.61	18.17
1875	9.49	2.66	0.24	1.23	1[illegible].62	1875	16.46	2.19	1.05	1.92	21.62
1874	5.71	4.70	2.32	1.09	13.82	1874	2.71	3.2[illegible]	0.62	2.[illegible]4	8.6[illegible]
Mean	5.55	3.97	3.46	2.41	15.42	Mean	6.19	3.34	1.98	3.44	14.96

CAIRO.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	2.91	3.16	3.08	1.64	10.79
1877	5.63	1.58	3.15	3.12	13.48
1876	3.44	5.24	0.73	2.14	11.55
1875	9.88	3.32	0.16	1.76	15.12
1874	0.52	2.79	3.14	1.54	7.99
Mean	4.18	3.2	2.05	2.04	11.79

MEMPHIS.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	2.38	1.59	2.60	2.83	9.40
1877	6.22	6.05	3.11	3.75	19.13
1876	4.38	5.37	3. 4	3.95	16.74
1875	4.34	2.39	2.94	2.38	12.05
1874	0.47	4.60	4.72	1.07	10.86
Mean	3.56	4.00	3.28	2.80	13.64

VICKSBURG.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	2.92	6.69	*2.33	3.40	15.34
1877	2.95	1.14	6.94	5.00	16.03
1876	3.34	2.86	1.95	2.21	10.36
1875	1.92	8.85	7.55	3.76	22.08
1874	7.39	0.06	6.20	0.00	13.65
Mean	3.70	3.92	4.99	2.87	15.49

*No record in first week.

GALVESTON.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	7.92	7.06	5.05	3.60	23.63
1877	1.89	1.27	13.85	17.39	34.40
1876	3.22	10.19	0.64	1.41	15.46
1875	1.11	6.15	18.41	1.79	27.46
1874	9.31	7.19	5.84	0.12	22.46
Mean	4.69	6.37	8.76	4.86	24.68

NEW ORLEANS.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	7.30	4.24	2.85	4.48	18.85
1877	6.41	2.54	13.21	9.15	31.31
1876	4.73	4.44	0.26	0.24	9.67
1875	6.67	8.61	7.89	2.09	25.26
1874	12.93	4.82	4.21	0.00	21.96
Mean	7.61	4.93	5.68	3.19	21.41

MOBILE.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	3.56	9.52	3.86	4.52	21.46
1877	3.74	4.69	12.68	6.15	27.26
1876	5.38	11.53	1.76	0.37	19.04
1875	4.00	7.07	8.52	2.32	21.91
1874	10.21	3.79	2.54	0.00	16.54
Mean	5.38	7.32	5.87	2.67	21.24

CHARLESTON.

Year	July.	Aug.	Sept.	Oct.	Total.
1878	11.11	13.48	8.28	3.96	36.83
1877	10.21	2.21	6.30	4.87	23.59
1876	11.26	5.10	11.26	14.32	41.94
1875	1.05	1.94	3.58	3.90	10.44
1874	13.74	7.06	6.66	1.85	9.31
Mean	9.47	5.95	7.22	5.78	28.42

NORFOLK.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	1.92	10.05	2.25	4.91	19.13
1877	7.9	3.78	11.90	7.82	31.47
1876	5.50	4.54	9.09	1.52	20.65
1875	4.72	10.37	2.05	3.21	20.35
1874	8.81	5.04	3.78	0.04	17.67
Mean	5.78	6.76	5.81	3.50	21.85

PHILADELPHIA.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	4.75	3.43	0.94	1.88	11.00
1877	5.53	0.66	2.74	6.52	15.45
1876	5.71	0.98	8.77	1.06	16.52
1875	3.63	6.42	2.53	1.42	14. 0
1874	2.25	5.65	6.01	2.87	16.78
Mean	4.37	3.43	4.20	2.75	14.75

The seasonal mean for the three Atlantic cities is 21.67 in.; that for the Gulf cities is 22.44 in., and for the five Valley cities, 14.26 in. As a rule, therefore, most rain falls along the shores of the Gulf of Mexico; a quantity which is a little less in the Atlantic cities, and but a little more *than two thirds as much* on the banks of the Mississippi river. We have found that these latter cities are, in general, cooler and less fair than the cities of the gulf; the rainfall, nevertheless, falls far short of that of cities on the coast. This is most probably dependent upon the average prevalence of thunderstorms, which we find to vary in a parallelism with the rainfall, being most frequent in the Gulf cities, less so in the Atlantic cities, and least so in the Valley cities. The mean rainfall of 1878, of the seven cities in which yellow fever occurred, is 15.14 in. This is based on the totals of four months. Now this figure is in close correspondence with the mean of the five years in several of the cities in which yellow fever prevailed, and a general disposition is observable towards an approximation of the rainfall for the four months of 1878, towards the mean of each of the cities for five years.

Thus, in St. Louis, the quantity of rain which fell in 1878, (summer months) was 15.48 in.; the mean for five years being 15.42 in.; integers the same, and even fractions nearly identical.

In Louisville the quantity was 14.68 in., the mean of the five years being 14.96 in.; integers the same.

In Cairo the rainfall for 1878 was 10.79 in., the mean of its five years being 11.79; a difference of only one integer in nearly twelve.

In Memphis the rainfall for 1878 was 9.40 in., which is about two-thirds of its mean seasonal rainfall.

In Vicksburg the rainfall for 1878 was 15.34 in.; that for its mean of five years was 15.49 in.; integers the same.

In New Orleans the rainfall for 1878 was 18.85 in., and its mean for the five years was 21.41 in. Here, as in Memphis, there is a diminution, but to a much less extent, the difference being only 2.56 in., or between an eighth and a ninth.

In Mobile the rainfall for 1878 was 21.46 in., and its mean for five years 21.24 in.; integers the same.

In four cases out of seven the integers have been the same, and in one case only, viz., Memphis, was there any noticeable declension from the mean of the local five years. It may, therefore, be regarded as quite true that in 1878 the quantity of rain

falling in the four months of summer, in those cities in which yellow fever prevailed, in almost every case, was very close to the average of five years—an observation strictly in accordance with theoretical demands.

Considering, in the next place, the months in which yellow fever appeared and was established in the several cities of our records in 1878, we find a similar accordance, though of course not quite so close.

In St. Louis the first case occurred in August (26th), nearly, we may say, in September. The conjoint rainfall of August and September was 8.42; sum of the monthly means for the same months, 7.43, the rainfall of September having the same integers.

In Louisville the disease prevailed in the latter part of September and in the first three weeks of October. The conjoint rainfall of these two months was 6.38; the sum of the monthly means for the same two months being 5.42, a closer approximation to the mean than can be found in any of the other recorded years for that city.

In Cairo the disease also prevailed in September and October, the sum of the rainfall for these months being 4.72, and that of the means of the same months 4.09. The integers are the same and the approximation closer than for any other year except 1874, whose figure is 4.68.

In Memphis the disease appeared and became established in August. The rainfall was much less than its monthly mean, and the condition cannot be regarded as favorable. We must recollect that the bayou into which Memphis is drained, being a pond-like collection of water, and intimately connected with the outbreak and prevalence of the disease, constitutes a condition which is independent of rainfall, and so also for privies and cow-stables.

In Vicksburg the disease appeared in August, whose rainfall was 50 per cent above its mean. Taking the two earlier months of its prevalence, August and September, together, we find the sum of their rainfall 9.02, and that of the means for the same two months 8.91, figures which are practically the same.

In New Orleans the disease appeared in July, whose rainfall was 7.30 in., the mean of the same month being 7.61. Here we find the integers the same. *The epidemic of 1878 began in a medium rainfull.* If, moreover, we take the combined means of the first two months of its prevalence, July and August, we have

11.54, that for the monthly mean being 12.54, a difference of but one-twelfth, and a far closer approximation than can be found for any other of the five years.

In Mobile yellow fever appeared in August, whose rainfall was somewhat more than a fifth in excess of its mean. The disease prevailed especially in September and October, the sum of whose rainfall is 8.38, the sum of the means for the same two months being 8.54, figures which are practically the same.

We may assert, from the foregoing, that the yellow fever of 1878, in nearly every city whose records we have, was not only attended with a rainfall which was the average of a series of years, taking the four summer months together, but that the correspondence of the figures proper to the months in which the disease originated, or to the two months in which it prevailed or was established and reached its greatest mortality, was quite as close as theory demands, when we consider the essential characters of the pluviometrical determinations already alluded to. Drought, therefore, is a condition in which yellow fever cannot exist, unless foci of putrefaction, independent of rainfall, are present, and the humidity be inordinately high. Moderate rainfall, equal to, or slightly less, than the mean of the season or months concerned, is the proper pluviatile condition of yellow fever.

Excessive rainfall, by causing the overflow of low levels, may induce yellow fever, but the disease so induced will not assume the proportions of an epi lemi exc pt whe e the total amo int of such extreme rainfall is made up by a small number of exceedingly heavy falls of rain, thus limiting the number of cloudy and rainy days, and allowing the concurrent action of the sun upon the soil.

ATMOSPHERIC HUMIDITY.

Next to the temperature and calmness of the weather, especially of the nights, humidity is perhaps the most important record in an epidemiological point of view.

The moisture contained in a vaporous form in the air, which we call humidity, is of course derived from moist or aqueous surfaces by evaporation. The rapidity of evaporation varies with the temperature, but the quantity of the vapor which the air can contain varies in a ratio which is not directly proportionate to the variations of temperature. As the act of evaporation con-

sists in the change of form of water, from the condition of a fluid to that of vapor, the rapidity of this change depends upon the tension of aqueous vapor at any given temperature. This tension becomes rapidly greater as the temperature increases, so that at high temperatures, the air may contain much more vapor proportionally, than at low ones, and evaporation is also far more rapid.

The vapor which is denoted by the records of humidity for any given place, is for the most part that which is present in the air which blows over such places. To a very great extent, therefore, the humidity of the air is dependent upon the direction of the wind, being greatest in winds which have passed over or through extensive swampy regions covered with luxuriant vegetation, where a high surface temperature also exists.

The air from the ocean is not by any means so humid as is generally supposed, although winds which course over warm tracts of sea, such as the Gulf of Mexico, or Mediterranean sea are well known to be laden with moisture. But the excessive degrees of humidity which accompany epidemics of febrile diseases, and especially of yellow fever, are due to *local evaporation*. The humidity in such cases is the result of the co-existence of smart rainfall and strong insolation. When the earth becomes greatly heated, if rain falls upon it, the tension of aqueous vapor being high, the water rapidly changes its state and passes into the superjacent air.

We must recollect that there is no active power resident in the air, by virtue of which the atmosphere takes up water from the surface, as is vulgarly imagined, but that the act of evaporation is purely a spontaneous one, the water passing off more rapidly as *its own* temperature is higher, being retained in the vaporous form, or losing it, according as the temperature of the air is high or low, or the quantity of vapor it already contains, as great as, or less, than that which it is able to hold between its particles at the given temperature.

If now the air be *motionless* over a heated moist surface, conditions are present which are most favorable to a high degree of atmospheric humidity, and these conditions, whether in the close court-yards of cities, in narrow streets, in the interior of ships navigating warm tracts of sea, or in towns built between eminences, or surrounded by fortifications, are such as eminently favor the outbreak of epidemics, and of yellow fever especially.

The influence of humidity is exerted both upon the earth's surface and upon the body. It is a well understood principle of physics, of very extensive application, that the humidity of the air tends directly to increase the temperature of the earth's surface. The light of the sun passes without difficulty through a transparent atmosphere, however laden with humidity, but falling upon terrestrial surfaces is mostly absorbed, and by a degradation of the velocity of its vibrations becomes transformed into heat. The rays of what we call heat, moving far more slowly than those of light (the slower undulations we call heat, and the more rapid, light) are unable to penetrate the vapor which exists in the superincumbent air, although passing readily through dry air. Return radiation being therefore impeded or impossible, the surface becomes hotter, with all things that rest upon it. Humidity of the air, consequently, directly enhances the temperature of the earth's surface and of all things upon it, including the human body. At the same time, the presence of vapor already contained in the air, by thus causing an unusual degree of surface temperature, still further promotes the extrication of aqueous vapor from surfaces which happen to be moist, so that under such circumstances, atmospheric humidity becomes a direct cause of its own augmentation, which, if the air be calm, may even progress to complete saturation of the atmosphere. This is what we experience on a fair day in summer after a smart shower without wind, and what is denoted by the word "sultry." Both the humidity and temperature become greatly pronounced when clouds cover the sky after such a shower, whereby return radiation is altogether obstructed, and the earth's surface prevented from cooling by radiation as it naturally tends to do, if such conditions exist at night. Such still, humid and hot nights, are indissolubly linked with the origin of yellow fever.

Besides this action of aerial humidity in causing an exaltation of terrestrial heat, we recognize another, equally potent, in inducing a rise of temperature in the human body. This principle is a familiar one, and is no more than that whereby a vapor-laden atmosphere prevents the evaporation of water from the skin and lungs. At high temperatures, although the air, even at 90° is of less temperature than the human body, but little heat is abstracted from its surface by the mechanism termed "convection", the body depends for its necessary refrigeration upon the evaporation of its fluids from appropriate tissual expanses.

When the humidity of the air is high, the temperature of the air being less than that of the body, but still what is called excessive, but little more vapor can be taken up by the air, and the perspiration rolls away in the fluid form. The immense refrigerating power of the vaporization of the perspiration and fluids of the pulmonary surfaces is thus lost wholly or in part, and the temperature of the body being unrestrained, is maintained at an abnormally high standard, which soon reaches a point at which febrile disease may be readily established.

The influence of high atmospheric humidity in exalting the intensity of febrile movements, and so tending to induce conditions of malignancy, deserves a passing notice. This influence, in the case of yellow fever, is but a continuation of those, viz., combined heat and humidity, which have mainly contributed to establish the predisposition towards fever, upon which the disease is based, by direct intoxication of the symptoms with septic effluvia. Fever is properly a reaction against such septic intoxication of the economy, and even in its milder degrees, against the general enhancement of the nutritive processes above a grade which the economy is able to support, effected by overflow from the lymphatic system of abnormally fermentative lymph, or the entrance into the circulation and system generally of the excited products of inflammation. In this reaction which we call fever, a certain moderate exaltation of the temperature above the normal grade, is a necessary part or condition of the process; for upon the enhancement of nutritive activity attendant upon this rise of temperature, all the steps of the reactive chain depend, by means of which the effects of the generalization throughout the system of the zymogenous causes of fever, are to be neutralized. An exaltation of bodily temperature to 101° or 102°, I have found by observation in yellow fever, to be abundantly high, and even at lower grades, though not below 100°, the reaction is nearly uniformly successful. We all know that unless the temperature exceeds 103°, we have nothing to apprehend from a febrile movement which is uncomplicated. In yellow fever, however, the temperature is habitually higher than this in "sthenic cases," so called, when the intensity of the lædent cause of the fever is such, that a wholly unrestrained and hyperpyrectic reaction is established, often within an hour or two after the first symptoms. The thermometer indicates temperatures of 106° to 108°, or even higher, as some say, though I have never seen it higher than this. The

economy quickly becomes "dissolved in this fervent heat," and after forty to sixty hours, every effort towards reaction becomes impossible, in the confessed failure of nature, which we call collapse. A low temperature of the air, and especially a low humidity, powerfully conduce towards that reduction of the temperature, which in medical practice is the first and most important indication. When, however, the temperature of the air is nearly equal to that of the body, and when the atmosphere is laden with humidity, conditions amid which the disease has arisen, and which by the supposition still continue, refrigeration by the process of sweating is almost or wholly impossible. Aqueous affusions are not evaporated, for the air possesses little or no drying power, and if recourse be not had to liquids which remove heat by convection, in consequence of their comparatively low temperature, or to such as being properly more volatile than the sweat or watery affusions, and are thus able to abstract heat from the parched body, itself at the time mostly incapable of sweating, the systemic temperature is not reduced, and usually mounts to a grade, by the accumulation of heat engendered in its own processes, which leads very promptly to a fatal exhaustion of nervous force. A high dew point is in this way equivalent to an exaltation of the atmospheric temperature, and must tend powerfully towards the aggravation of the disease when already established by allowing the temperature of the body to attain the exorbitant grade, which in yellow fever it is naturally prone to reach.

The humidity of the air, still further exerts a most important influence upon the beginnings and progress of putrefactive fermentation. Putrefaction *begins* upon surfaces in contact with the atmosphere, and where these remain moist, at suitable temperatures, is promptly established. If, however, the air be dry, these moist surfaces are cooled down by evaporation of their water, and their temperature reduced along with that of the mass they limit, considerably below that of the air; decomposition is thus *pro tanto* impeded. At the same time, in virtue of this surface evaporation of the fluids of the fermentable material, the whole exterior hardens, becoming desiccated, and so upon its surface, insusceptible to putrefaction through deficiency of water. This takes place when a quarter of beef is carried to a height, such as the top of a tall tree, (a method often practiced at the South) where if it be shielded from the direct rays of the sun, it will resist putrefaction for several days, while on the sur-

face it would have entered speedily upon this process. As all fermenting substances liberate heat within their mass, an active evaporation proceeding upon their exterior, necessarily lowers the general temperature, and in so much retards the putrefactive process, and delays and lessens the extrication, along with vapor of water in the form often of a condensed steam, of those deleterious gases which deprave the constitution of the blood, and the minute particles in proper kind, of the putrefying substance itself, which alike affect the sense of smell, and are capable of establishing fevers of septic character.

The degree of atmospheric humidity is most accurately estimated by observing the highest temperature at which the moisture of the air is condensed upon any cold body; this temperature is called the "dew point." Since the evolution of aqueous vapor depends upon the temperature of the moist surface which emits it, while its retention in the air, unprecipitated, depends upon the temperature of the air, exposure of moist surfaces being presupposed, the humidity of the air should increase as the temperature rises. For comparatively long periods of time, weeks, months and seasons, the dew point will be found to follow the temperature by a similar though disproportionate motion, as the barometrical indications do by a reverse movement. Müller states that the absolute quantity of water in the air, like the mean temperature, is greatest in July and least in January, and that the *diurnal* variation of the dew point is directly controlled by the temperature. Espy observes, "It has been ascertained that the quantity of vapor in the air is increased as the temperature rises with the ascent of the sun. This, however, lasts only until nine o'clock, when the ascending currents of air, occasioned by strong heating of the soil, carries the vapor upwards and away, so that the water contained in the lower strata of the atmosphere diminishes, although the formation of vapor continues with the increase of heat. This diminution is apparent until four o'clock, when the quantity of water in the lower strata of the air again increases, because the upwardly directed currents of air cease to carry away the vapor formed. This increase of humidity continues but until 9 P. M., or thereabout, because the decreasing temperature of the air puts a limit to the further formation of vapor." This would be stated more correctly, "decreasing temperature of the soil," for the temperature of the air and the evolution of vapor both depend upon the temperature of the surface of the earth.

As I have said, the dew point varies in the same direction as the temperature, and is controlled by it in a general way, but nevertheless, does not vary directly with the temperature, being subjected to the influence of the laws governing the progression of the tension of aqueous vapor at increasing temperatures. When the thermometer, in air theoretically saturated with vapor, sinks through 10 degrees of the scale, the dew point will sink, at the same time, through 15.4 degrees, the vapor, which had been able to retain its gaseiform state above this point, being "precipitated," and appearing as mist or cloud, and so, proportionately, in *decreasing ratios*, for declensions of temperature of *equal extent*, lower on the thermometer scale, and in *increasing ratios* for declensions of temperature of the same number of degrees at temperatures higher than 80°. The annual or seasonal range of the dew point is thus greater than that of the thermometer, as will be seen from the following figures, calculated from the Charleston records, which show the mean monthly dew point at sunrise, and the mean temperature, estimated from a series of twelve years:

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temp	49.49	51.76	57.9	64.9	72.39	77.5	80.66	80.35	75.[illegible]	66.60	58.54	51.82
Dew point.	41.86	43.0	48.6	56.02	64.00	70.88	74.22	74.18	68.8	58.08	49.9	44.18

Both minima occur in January, and both maxima in July, and the increase and decrease in both series is quite similar, though not strictly parallel, representing different curves. Thus the range of temperature for the year, between January and July, is 31.17°, while that of the dew point, between the same months, is 32.36°. The dew point range is thus found, by a comparison of secular means, to be greater than that of the temperature, which is in confirmation of the theory of the subject. A comparison of the means for single years shows the same difference, as a rule, although the great fluctuations to which the humidity of the air is subject, is frequently denoted by an irregularity of the figures, which is of course balanced, under the domination of the general law, when the mean of many years is taken. On comparing the respective ranges of the dew point and the thermometer for seventeen single years, from 1844 to 1860, I have found that in thirteen years the dew point range was the greatest. In four only, was the range of the dew point less than

that of the thermometer, viz., 1860, 1858, 1856 and 1850. In all these cases the integers expressive of degrees were the same, the excess of the temperature range, over that of the dew point averaging 0.54 of a degree, while the average elevation of the dew-point range over that of the temperature is 1.19°. Similar results are obtained by a comparison of the means of the three summer months. Thus, in a series of sixteen years, on comparing the mean temperatures with the dew point, we find that the maxima of temperature coincide with the maxima of the dew point, and so, likewise, for the minima of both. The thermometrical range is 3.82°, and the dew point range 5.98°. In any given year, moreover, the month of highest or lowest temperature is nearly always the month of highest or lowest dew point. These months are by no means the same for every year, and when, exceptionally, the maxima and minima occur in different months, these months are nearly of the same intensity.

The dew point is thus controlled by the temperature, and its range is simultaneously greater than that of the temperature of the air, for reasons of a physical character already alluded to.

These considerations show that the humidity of the air is not dependent upon the direction of the wind, though distinctly and often very greatly influenced thereby, but upon seasonal, monthly and diurnal variations of temperature. The influences, therefore, of a local character, which affect the dew point, are even more numerous than those which affect the temperature, since they include all of this latter class and many others likewise. Among these, inasmuch as they exert a very strong influence on the origin as well as progress of various forms of fever, including yellow fever, we may enumerate the proximity of the ocean, of rivers, of wide expanses of marshy or swampy territory, like those in the vicinity of Charleston and New Orleans; dense building, as in the older parts of some Southern cities; inadequate drainage of alleys, court yards, and vacant lots; inadequacy of ventilation, as in closely-built houses on the ground floor, and in the interior of ships; the presence of heated bilge water in ships at rest in warm harbors, or sailing in the gulf stream, or in warm seas; the presence of heated ballast taken in from the shores of hot countries; the presence of cargoes of partly-damaged grain, of fruit, or of other moist, fermentable material. Under such circumstances, a very notable exaltation of the humidity occurs, due entirely to conditions

which may be so strictly local as to affect the atmosphere even of a single house, or of one apartment only, whose humidity, therefore, is not at all indicated by the general cotemporary records of a public character. This is to a considerable extent true, likewise, for the temperature, and I have also called attention to the same inadequacy of the rain record. I may still more distinctly enunciate this very important matter, by saying, that the morbific effects of a high temperature and humidity, and of the rainfall, are always far more intense than the exaltation declared by the published records would lead us to suspect; because these three conditions are *necessarily* intensified to degrees far beyond those determinable at the central office of record, which is always located in the best parts of cities, and in the best buildings. This undetermined intensity exists in those localities which are badly drained and ventilated, and situated in the overcrowded and densely built parts of cities, and usually inhabited by the poorer classes, where, consequently, the first cases of epidemic fevers originate, and where epidemics naturally find the greatest number of subjects. The temperature and humidity of the interior of ships is, for similar reasons, wholly different from that of their decks, a consideration to which very little attention seems to have been paid, notwithstanding the large part which ships play in the dissemination of contagious diseases, and the number of instances in which such diseases *originate* on shipboard, under conditions precisely analogous to those proper to the land. In places and under circumstances such as I have described, the humidity may rise to an altogether unsuspected height, or even to complete saturation, while as yet the atmosphere generally, at sea or on land, does not contain a very large amount of water, as indicated in the standard registrations. Even in cool weather, or the depth of winter, an excessive humidity and high temperature may cöexist in buildings or apartments closed against the external air. Where the laws of health are not understood or acted upon, such conditions are very common or nearly universal in the cold weather of winter. Thus, in Russia and Asia Minor, the better classes of peasantry live under the *same roof* with their domestic animals, keeping all the insufficient openings closed, as much as possible, to keep out the external air. This is done for the security of the animals, sometimes, but it is expressly admitted that the practice is followed, in a great degree, for the saving of fuel which is thereby effected.

where fuel is very scarce; the natural heat of the animals, and that due to the fermentation of the compost on which they rest, keeping up the temperature of the interior of the one-storied buildings, in which the parts occupied by the family are separated by a mere railing from those devoted to the horses, cattle and sheep.

I now pass on to a short examination of the records of the humidity in Charleston, with reference to its relation to yellow fever. As these records have been kept since 1845 only, the series of years is not as long as that at our command for the temperature. The record, moreover, has always been made in terms of the "dew point" and I shall present them accordingly, for all the years whose record can be obtained up to 1878, under that denomination. Below is subjoined,

Table R, showing the increments of the dew point for the months of August, September and October conjointly, for twenty-four years:

Years.	Dew Point.	Hygienic Annotation.	Years.	Dew Point.	Hygienic Annotation.
1854	70.20	Yellow Fever.	1850	66.54	....
1855	69 11	....	1857	66.43	....
1846	68.51	....	1865	66.00	....
1858	68.20	....	1867	65.89	....
1868	68.51	....	1851	65.74	....
1847	67.03	....	1848	65.69	....
1853	66.98	....	1866	65.58	....
1878	66.81	....	1874	65.55	....
1856	66 79	....	1876	65.11	....
1877	66.76	....	1869	64.94	Healthy.
1852	66.58	....	1845	64.22	Healthy.
1849	66.55	....	1875	34.96	Healthy.

The maxima coincides with the great epidemic year of 1854 and the minima with healthy years; annexed is a table of the means:

Table S, showing the progression of the means for table R:

Yellow Fever Years.	Healthy Years.
Mean.......... 66.76	Mean.......... 66.45

The progression is regular, and confirms the indications of the preceding table. The mean of 1854, 1858, 1856, and 1852, years of the greatest epidemicity, is 67.94. As we have in this table but twenty-four years, the number of least epidemic and of sporadic years is not sufficient to allow reliable means to be

drawn from them; they have, therefore, been included as "yellow fever years," with the greatest epidemic years.

From these records, therefore, the dew point is a primary agent of the second rank in the production of yellow fever, acting mostly through its influence in exalting the action of temperature upon the surface of the earth, upon the inception and progress of putrefaction, and upon the temperature of the human body both before and after it has been affected with yellow fever. It will be seen from the table that yellow fever of even the lowest intensity, has never existed in Charleston with a dew point lower than 65.11, which is within one degree of the mean dew point for all years. The greatest epidemics have each affected a seasonal dew point higher than the mean of all the years, the great epidemic of 1854 heading the series. With regard to the influence of the dew point, Barton, of New Orleans, in his laborious report, which was published after the researches from which the above tables are abstracted were made, remarks: "Fevers do not prevail *in proportion* to the height of the dew point, but they do not prevail without a high dew point." That is, a large amount of moisture with a high degree of heat is essential to the development of high grades of fever. Moisture (humidity of the air), no doubt, is the controlling sanitary condition at all high temperatures. We do not pretend to say that yellow fever is rife in proportion to the amount of moisture existing in the air, but we doubt not that a large amount of it is *indispensable* for it. Dr. Home, in Flanders, measured daily the degree of moisture of the air, and on comparing his tables with the register kept of the sick, he found that the progress of the disease kept pace, as far, he says, as anything of the kind can do, with the humidity of the air. The whole meteorological condition has been kept by me for many years, including the hygrometry, and it has always appeared to me that the *direct* influence on the health of individuals, with its varying conditions, not only in yellow fever, but with large classes of disease, has been clear and unequivocal. Its influence in 1853 I have shown to be very conspicuous."

The extension of epidemics through the months of September, October and November, is greatly due to a sustained high humidity. Thus, in the great epidemic of Charleston of 1858, the dew point of October was 62.19, the highest of twenty-four years. In the next greatest epidemic, that of 1854, the dew point of August was 77.29, highest for the twenty-four years; for Sep-

tember, 73.83, also the highest for the same years, and for October, 59.22, within three figures of the maximum of all the years.

In 1852 the next greatest epidemic, the dew point for October, was the highest of the twenty-four years, except that for the same month of 1858.

We pass on, now, to an examination of the humidity of the year 1878 in the West and Southwest, in connection with the yellow fever epidemic.

The figures given below, denote the temperature of evaporation, or the indication of the wet bulb thermometer. I have already stated my reasons for choosing this record of the humidity in preference to that of the "relative humidity" or the "dew point." As the record for atmospheric moisture is expressed, in the Signal Service, in terms of *relative humidity*, I have first calculated, with the assistance of Glaisher's Hygrometrical Tables, the weekly wet bulb temperature, on the basis of the weekly mean temperature (which is identical with the weekly mean dry bulb temperature), and the mean weekly relative humidity. No terms, moreover, of the humidity are published in the annual reports of the Signal Service, and in order to obtain monthly means from the weekly means of the wet bulb, I have been obliged to resort again to proportional adjustment for those weeks which neither began nor ended on the first or last day of any month. This has been very laborious, but the method is an accurate one, and is, besides, the only one by which these figures could have been obtained at all. These expressions of the humidity of the air are in direct relation to its action on the human body, and upon the temperature of the earth's surface, as I have already observed.

Subjoined is a table showing the wet bulb temperatures, or temperatures of evaporation, for each of the five years and eleven cities, with the monthly, seasonal, and great seasonal means:

ST. LOUIS.						LOUISVILLE.					
Year.	July.	Aug.	Sept.	Oct.	Mean	Year.	July.	Aug.	Sept.	Oct.	Mean
1878	72.69	67.03	60.41	50.98	62.78	1878	71.86	68.35	59.85	48.78	62.21
1877	69.32	67.40	62.52	54.31	63.39	1877	70.63	8.37	62.15	54.16	63.83
1876	71.85	71.01	61.49	46.17	62.63	1876	71.44	70.34	60.64	45.76	62.04
1875	72.24	65.68	59.06	47.14	61.03	1875	72.55	64.60	58.90	45.93	60.49
1874	70.25	69.00	62.69	50.58	63.38	1874	70.16	68.36	62.77	49.63	62.73
Mean	71.27	68.02	61.23	49.84	62.64	Mean	71.33	68.00	60.86	48.85	62.26

CAIRO.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	75.84	73 80	62.91	53 13	66.42
1877	71.55	69.62	63.95	55.09	65.05
1876	71.98	71.85	62.20	47.19	63.30
1875	73.81	67.77	61.26	49.26	63.02
1874	74.10	71.68	64.97	51.36	65.53
Mean	73.45	70.94	63 06	51.21	64.66

MEMPHIS.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	75.92	74.07	63.87	54.57	67.11
1877	72.88	71.33	63.49	56.69	66.40
1876	74.12	73.31	63.27	50.34	65.26
1875	75.17	68.56	63.30	51.12	64. 4
1874	73.32	72.46	66.62	52.70	66.27
Mean	74.28	71.95	64 11	53.08	65.92

VICKSBURG.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	76.77	76.80	69.49	58.73	70.45
1877	74.36	75.02	69.55	60.24	69.79
1876	75.71	74.63	66.66	56 00	68.25
1875	75. 9	70.85	66.44	55.61	67.09
1874	73.33	74.49	68 72	55.44	67.99
Mean	75.05	74.36	68.17	57.20	68.70

GALVESTON.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	78.53	77.97	72.88	65.83	73.80
1877	77.02	76.20	73.92	66.78	73.48
1876	77.38	77.32	70.68	63.64	72.25
1875	76.85	75.90	70.30	64.58	71.96
1874	76.45	77.59	73.98	64.49	73.13
Mean	77.25	77.00	72.35	65.06	72.92

NEW ORLEANS.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	77.02	76.57	71.75	62.97	72.08
1877	75.33	74.34	72.28	63.41	71 34
1876	76.04	75.30	68.50	58.80	69.66
1875	75.45	73.47	69 89	59.72	69.38
1874	74.85	76.46	72 46	61.10	71.22
Mean	75.74	75.23	70.98	61.20	70.74

MOBILE.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	77.62	77.19	70.99	61.62	71.85
1877	76.12	74.08	72.28	62.48	71.24
1876	76.29	74.19	68.04	57.61	69.03
1875	76 03	72.69	69.13	57.78	69.81
1874	72.97	77.04	71.59	59.63	70.31
Mean	75.81	75.04	70.41	59.80	70.45

CHARLESTON.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	76.66	75.21	71.96	60 96	71.20
1877	76.51	75.72	71.23	63.22	71.67
1876	76.41	75.61	70.99	56.84	69.96
1875	77.71	73.88	68.76	57.49	69.46
1874	74.82	72.68	70.84	60.87	69.80
Mean	76.42	74.62	70.76	59.88	70.42

NORFOLK.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	73.67	72.43	67.60	55.54	67.31
1877	73.29	72.92	64.93	57.29	67.11
1876	73.37	71.88	63.80	49.80	64.71
1875	74.06	71.76	62.16	53.14	65.28
1874	70.51	67.10	65.29	53.99	64.22
Mean	72.98	71.22	64 76	53.95	65.75

PHILADELPHIA.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	68.91	66 06	61.74	49.83	61.63
1877	68.83	68.08	60.28	51.84	62.26
1876	69.22	66.60	57.40	45.06	59.57
1875	66.77	66.79	55.40	47.04	59.00
1874	66.41	61.69	60.38	47.13	58.90
Mean	68.03	65.84	59.04	48.18	60.27

The great season mean for the three Atlantic cities is 65.48°; that for the five Valley cities is 66.84°, and for the three Gulf cities 71.37°. The movement is the same as that observed for the temperature and the clear and fair days; the mean summer humidity of the Gulf cities is greatly the highest; that of the cities of the Mississippi Valley the next highest, and of the cities of the Atlantic seaboard, notwithstanding their proximity to the ocean, lowest of all. This high humidity of the Gulf coast and the river margins must, I think, be attributed to the warm waters of the Gulf of Mexico, and to evaporation from the swampy alluvial tracts bounding the river, the fertile tracts, where reclaimed, in common with the natural soil, being everywhere covered with luxuriant vegetation. The soil moreover is impervious to water, in this great valley, and the rainfall either flows off by the water courses or is evaporated from the surface; it does not sink into the earth, as in districts where the surface soil is sandy. The atmosphere in consequence, is naturally laden with vapor, derived both from evaporation and from the prodigious extrication of water by the leaves of trees and cultivated plants, and the natural herbage of prairie tracts and disused fields. I cannot help thinking that this humidity is the principal *cause* of the *greater temperature* of the Gulf coast and valley, and not its effect upon principles already alluded to. The high humidity prevents return radiation by day as well as by night, and so effects an exaltation of terrestrial temperature by accumulation, and secondarily, a higher temperature of the air which rests upon the surface. This result is less marked in rural districts than in cities, because the act of evaporation from the leaves of plants, causes a reduction of temperature in the air in contact with them; but in cities where there is no vegetation worthy of notice, the full effect of the humidity in enhancing soil temperature, and the temperature in general of buildings, pavements, court yards, etc., is experienced. This increased heat still further acts, as I have said, in causing a still more active evaporation from moist surfaces, and so again exalting the existing grade of humidity, especially when the air is calm and the sky veiled.

It will be observed that *the seasonal mean for 1878, is greater* than the mean for five years, *in every one of the eleven cities.*

In Cairo, the mean for 1878 was greater than in any one of the five years. So also in Memphis, Vicksburg, New Orleans and

Mobile, in each of which cities yellow fever prevailed. The mean humidity of the season of 1878 for the seven cities in which yellow fever prevailed in that year, is 67.56; while that of the four cities in which the disease did not prevail is 65.98.

Let us examine now the *months* in which the yellow fever appeared in each of the cities more or less affected in 1878.

In St. Louis, the first case occurred in August; but the humidity of the month was lower than its mean. In September the humidity was likewise lower than its mean, but in October, in which the greater number of cases occurred on the Quarantine steamer and at Quarantine, the humidity was above its mean.

In Louisville, the first case occurred in September, and the humidity was above its mean.

In Cairo, the first cases occurred in September, whose humidity was very near its mean, the humidity of the two previous months having been greatly above their means. In October, when the disease prevailed as an epidemic, the humidity was considerably higher than its mean.

In Memphis the yellow fever appeared in August, whose humidity, 76.92°, was the highest for five years. The humidity of August was also the highest for five years. In September the humidity declined to a point somewhat lower than its mean, rising in October above the mean of that month.

In Vicksburg, the disease also appeared in August, whose humidity, 76.80, was the highest for five years. The humidity of September was practically the same as that of 1877, higher than the mean. The humidity of October was also higher than its mean.

In New Orleans, the humidity of July, in which month the disease first appeared, was 77.02, the highest of five years. That of August was also the highest of five years. That for September was higher than its mean, and so also was the humidity for October.

In Mobile, the first case occurred in August, whose humidity was the greatest of five years, that of the month previous having also been the highest for five years. In September the humidity was above its mean, and so also on October, the month in which the greatest number of cases occurred.

SUMMARY.—The humidity of the summer of 1878 (seasonal mean) was unusually high in every one of the eleven cities; in five of the cities visited by yellow fever, it was higher than in

any of the five years. The humidity was greater in all those cities in which yellow fever appeared, than in all those in which it did not.

In the month in which yellow fever appeared, the humidity was above its mean in five of the seven cities, and the greatest *for five years*, in four, viz., Memphis, Vicksburg, New Orleans and Mobile. In St. Louis, Louisville, and Cairo, the humidity was above its mean in that month in which the greatest number of cases of local origin occurred.

The lowest humidity at which yellow fever appeared was 59.85°, in Louisville, in September; the highest, in Mobile, viz., 77.19°, for August. The humidity of July in New Orleans was 77.02°, a figure which was nearly reached in Vicksburg (humidity of August, 76.80°) but not so closely in Memphis, (humidity of August, 74.07°). We may conclude that a temperature of evaporation of 77,° existing early in the season, exerts a most powerful influence in originating the disease, while a continuance of an unusually high grade of humidity, even if the absolute height be much below this point, will equally facilitate an acceptance of contagion or cause a local outbreak at a period of the season which is delayed in proportion to the lower range of the humidity. Hence it was, presumably, that St. Louis, Cairo and Louisville were not touched materially by the fever until October, and hence also, the delay of the disease in reaching Vicksburg and Memphis for a month after it appeared in New Orleans.

ATMOSPHERIC CURRENTS, WINDS AND CALMS.

The movements of the atmosphere in a general sense, are wholly due to differences of temperature between the soil and the air which rests upon it. Atmospheric currents of all kinds, excepting those attributable to electrical and hygrometrical influences, are caused by the cooling or heating of the surface stratum of the atmosphere. The transference of heat so implied is not effected by *conduction*, for the power of propagating heat from particle to particle, is possessed by fluids only to an exceedingly slight degree, and by gases most probably not at all. The change of temperature is therefore accomplished by the mechanism known as "convection," in both fluids and gases. Only the particles of air or water which come directly into contact with a solid are affected by its temperature, changes of specific gravity

in the gas or fluid ensuing, if they are of a different temperature from the substance on which they rest, whereby more or less regular currents are established, so that all the particles of the mobile matter are eventually brought into contact with the modifying surface, and an equilibrium of temperature established between the solid and fluids or gases concerned.

Heat is imparted from the earth to the atmosphere almost exclusively in this way, and motion of the air necessarily results. So also, when the heat is transferred from the air to the soil, motion of the surface stratum of the atmosphere likewise occurs, if any exit towards a lower level be afforded to the air thus increased in density by cooling.

During the day, the air receives heat from the earth, and being thus rendered specifically lighter, is pressed upwards by the greater weight of colder and denser columns around. What are known as the "diurnal ascending currents" are thus set in motion over all surfaces heated by the sun. If these currents arise from a heated plain, cooler air flows in laterally, as from forests, bodies of water, or the ocean. If the surface be inclined and elevated, air is forced upwards from valleys and plains of lower level, to rise, after being itself heated, towards the summit of the elevations.

This occurs during the day, but at night, on undulating surfaces, currents are established just the reverse of those described. The surface, cooled by radiation, cools the air in contact with it, which sinks along the slopes, with a velocity proportional to their steepness. Downward currents, towards all lower levels, begin to flow, following the natural water-leads, invisible, if not cooled down below their dew point, but charged with fog, if their humidity had been unusually high, or the cooling sufficient to precipitate their aqueous vapor. These motions are established as soon as the earth becomes cooled by radiation below the temperature of the air which lies upon it, and continues all night, or until all lower areas without exit are filled with the cooled and fog-laden air. All the emanations from the surfaces down which the air has rolled are taken with it towards lower levels, so that the fog becomes *accidentally* associated with such effluvia. Fogs in general are due to the cooling of humid air, and remain where they are formed until the following morning, when they are lifted up and swept away by the establishment of the diurnal currents.

The phenomena described above, in so far as the air removes with it all volatile matters extracted along its path, as water washes away the soluble matters it meets, and as they occur only at night, may be termed "nocturnal aerial drainage." Cities built upon undulating ground, are therefore cleansed by reason of the steepness of their declivitives, both by the rainfall, and by this nightly downward flow of the air, and are consequently in the best hygienic conditions possible.

It must not be forgotten, however, that persons living on the sides of acclivities are exposed to the action of both the water over flow from above, and the unhealthy influences of miasmatic substances brought down in the descending air currents of the night, and still further, that the inhabitants of places of lower level, are thus doubly liable to injurious affection, both by inundation of the drainage water and its stagnation and putrefaction around them, and by the overflow of air charged with the steams and unhealthy miasmata given off from superior inhabited levels. It is for this double reason, that in undulating cities, such lower areas are always given up to the poor, and are known to be sickly. To the natural disadvantages of such a position is commonly superadded that of the necessary filling with matters of the most objectionable character, which for a very long time contaminate the air, and if wells are dug, render the water necessarily unwholesome.

The places just described, shallow excavations of low site, often originally ponds, are analogous in their relations to the nocturnal movements of the atmosphere to *level areas.* We have seen that during the day the sun's heat establishes a system of ascending currents from all surfaces, whether level or inclined—and that reverse currents are similarly set in motion by the refrigeration of the air on undulating surfaces after nightfall. On *flat surfaces* the diurnal ascending currents cease after the earth has cooled to the temperature of the air, but the air still continues to decline in temperature, often until its dew point is reached, if the humidity be high, receiving into its surface strata all the exhalations of the soil or of places whose temperature has failed to decline on account of the neighborhood of buildings, the interposition of sheds or coverings of any kind, or the foliage of trees between themselves and the sky. This surface stratum of cooled air naturally tending to flow off towards a lower level, is now unable to do so, and if winds do not blow, remains neces-

sarily motionless until the following morning. All night long the extrication of miasmatic substances continues, and the stagnant air becomes densely charged with such matters, as well as with vapor given off from the surface in general, and from lots and covered areas whose soil temperature has not declined. A condition of very high humidity and of miasmatic inquination is thus attained. This stillness of the surface stratum of air at night is a phenomenon of the highest importance in the etiology of febrile diseases due to malaria, or to the miasms of cities. In a flat country, smoke from a chimney is seen to rise obliquely during the day, finally mingling with the clouds, being borne aloft on the ascending currents of air; but in the early morning, before these currents of air are set in motion, it is seen to stream away in the same horizontal stratum in which it has been emitted, and may be followed for miles at exactly the same distance from the surface, except when it meets a forest, when it rises just high enough to pass over the trees. This is owing to the higher temperature of the woodland over the surrounding country. The smoke of a fire built upon a vessel in the center of a body of water, in the still air of the morning before sunrise, rises gently to a certain height and soon sinks upon the water, flowing off in direct contact with its surface. The smoke of a cigar is wafted upward during the day, with rapidity, if the sun be shining; but at night, if there is no wind, it remains where it was emitted, or even sinks towards the ground.

The sense of smell affords illustrations of the immobility of the surface stratum of air at night in general, which becomes absolute, if the wind does not blow, on all flat surfaces. Effluvia of all sorts are nearly imperceptible in the daytime, but are readily perceived at night. The "scent" of wild animals lies best at night and in the calm air of the morning before sunrise, and the hunter knows that to be successful he must lead his hounds to the field before the sun is up. All animals which follow their prey by the sense of smell do so by night. The odors they follow are quickly dissipated by day in the ascending currents. The host of offensive and noxious smells liberated from the streets, lots and drains, privies, cow-lots and stable yards of cities, and more or less wherever men abide, are nearly or quite imperceptible during the hours of sunshine, but become very distinct and often insupportable by their accumulation during the night. The musty and offensive emanations of ponds,

marshes and swamps are not noticeable during the day, but become recognizable enough at night, and are asserted by the countryman to be most dangerous "before the dew is off the ground," that is, before they are removed in the stratum of air in which they lie, by the ascending currents of the morning.

We must recollect that as water lies at the lowest attainable level, and its surface is not only a plane one, but preserves a temperature, in large bodies, which is lower than that of the dry-land in the summer months, the surface air gravitates directly towards all tracts of water that may lie within or near the area of cities. It must do this even when the differences of level are not more than a few feet. The surfaces of such collections of water, overflowed by the lateral movement of humid air from neighboring tracts of land, and, also, by the condensation of their own vapor in the cooler, over-hanging masses of air, becomes covered with mist and fog. Such mists, therefore, contain the miasmatic effluvia of the adjoining localities, and sleepers upon decks of boats, or in dwellings on the margin of ponds, lakes, bayous or harbors, are more apt to be injuriously affected by them. It is to this we must attribute the unhealthiness of such places of abode in the hot season, at wharves or in vessels moored in streams in close proximity to cities, swamps and marshes.

We must recollect that as putrefaction is mostly controlled by temperature, it is necessarily most active during the day. The effluvia which it evolves, however, are quickly dissipated by the ascending currents, so as to be scarcely appreciable to the sense of smell, or very dangerous to health. At night, on the contrary, although the activity of decomposition is lessened, and the absolute amount of miasmatic substance diminished from surfaces looking towards the sky, a progressive accumulation of such miasms takes place if *there be no wind*, in virtue of which a very high degree of intensity is quickly attained. Nor must it be forgotten, that many sources of miasmatic effluvia are in action even after nightfall, such as privies, cemeteries, stables, masses of stagnant water, the contents of foul cellars, the slime of half-dried ponds or recently overflowed tracts. All of these continue to inquinate the air, as much by night as by day, while their effluvia are not removed by the motion of the atmosphere. It is in view of these considerations that the night air is dangerous to health, and that the pestilence is said to "walk in darkness."

Although stagnancy of the air is especially a nocturnal phenomenon, it is not wholly so. Absolute calms not unfrequently occur during the day, especially at certain seasons of the year. They prevail under these seasonal influences both during the day and night, and it is under such conditions that the surface strata of air on flat surfaces remains almost or wholly motionless. Calms, whether by day or night, are more frequent about 30° north of the belt of the earth's greatest heating, on the circle of latitude where winds blowing in general from the south and southwest, are gradually giving place to those blowing from the north and northeast. The whole system of winds is yearly shifted from north to south, centering as far as the configuration of continents allows, upon that belt of the earth within the tropics, which has just attained its highest temperature. The air which is heated on this belt, and on both sides of it as far as the sun's influence extends, streams towards the poles, after rising to the highest regions of the atmosphere, but the greater part seeks that pole which is nearest. In our hemisphere, these currents constitute the southwest winds, which prevail in the latitude of Charleston, as a mean, from March to August. Their direction is then shifted, giving place for the other six months of the year, to winds blowing from the northeast. These latter winds are the return currents from regions further north. The obliquity of both sets of winds to the meridian, are of course due to the axial motion of the earth, and the diminishing length of a circle of latitude as we approach the poles, on a principle which is too well understood to need elucidation. It is at the season of the year that these southwesterly currents begin to give place to the northwesterly return currents that calms are characteristically frequent. As already hinted, the sun in our hemisphere is already six or seven degrees south of the northern tropic, when his maximum influence is felt over regions north of latitude 23° 28′. The belt of greatest heating, due to the perpendicular position of the sun, and to the fact that within the tropics, the sun shines vertically down on any given point, both as he proceeds northward, and after the summer solstice, to the south again, must be regarded as lying directly under the sun's place on its southward journey. This corresponds to the 12th of July.

Calms begin to be felt some thirty degrees north of this, in latitude 45°, with irregularities which are due to the influence of mountain streams, altitude of the surface, proximity of large

bodies of water, and a variety of other considerations. The belt of calms is, therefore, generally about 37° north of the sun's place, and proceeds southward with the movement of the sun. The territory between latitudes 40° and 29°, say from Philadelphia to Galveston, is traversed by this belt of calms in about six weeks, viz., by the 20th of August. Half the distance, or latitude 34° 30′, nearly the latitude of Memphis (35.07°) will be reached by the 1st of August. In St. Louis, Louisville and Cairo, calms are to be expected late in July, which accords mostly with the records of the signal service on a basis of four years addition. In Memphis and Vicksburg, I find the maximum of calms occurs in the summer and autumn, when four years are added together, in August. In the Gulf cities the maximum calmness is likewise in August.

The sum of all calms for each month for the years 1874, 1875, 1876 and 1877, and for the eleven cities conjointly, is subjoined. August is then seen to be the month of calms in general. It is more so strictly for the latitude of Charleston. For all the Southern Atlantic and Gulf seaboard, August is essentially the month of calms. The month of September is nearly as calm as August, and October but very little less so. These three months together, in which yellow fever prevails, are the calmest of the whole year by far.

Month	Jan.	Feb.	M'ch	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Total	272	224	214	195	172	177	314	364	352	347	213	231

That this calmness of August coincides with the change of direction of the wind from southeast to northeast, is seen from the following figures, computed from twelve successive years, from the Charleston records.

Jan.	Feb.	M'ch	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
N E	N E	S W	S W	S W	S W	S W	S W	N E	N E	N E	S W

These are the general laws of calmness of the days or nights due to the influences of the seasons. Great irregularities are experienced in different years, however, in this respect, successive years even varying greatly.

The different cities we are considering, show also a very variable frequency of calms. Thus the *mean* number of calms for the several groups of cities are as follows:

	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Atlantic Cities............	4.6	10.6	14 0	13.0	9 0	3 0
Gulf Cities	14.0	16.7	11.3	11.6	11 6	20 0
Valley Cities.............	51.6	56.4	55.4	54.6	30.2	32.2

It will be seen that the Atlantic cities are the least subject to calms, the Gulf cities more so, and the Valley cities more than three times as much so.

In the period of four years (1874 to 1877), we count the entire number of calms occurring as follows:

St. Louis, 105; Louisville, 497; Cairo, 465; Memphis, 575; Vicksburg, 696; Galveston, 42; New Orleans, 177; Mobile, 265; Charleston, 73; Norfolk, 119; Philadelphia, 61. St Louis is as breezy as Norfolk. The very remarkable disposition to calmness in Louisville, Cairo, Memphis and Vicksburg, is worthy of note. The disposition towards stagnation is most pronounced at Memphis and Vicksburg, and the significance of this with reference to the liability of these cities to yellow fever, will not be forgotten. Galveston is seen to have less frequent calms, owing, no doubt, to its insular as well as littoral position, than any other of the eleven cities, and in this fact we find one of the explanations of its coveted immunity from fever in 1878. Charleston is not very subject to calms, nor to great epidemics of yellow fever, which do not prevail more frequently than once in eight or ten years. Between 1832 and 1878 inclusively, a term of forty-six years, the records show seven greatest epidemic years, seven lesser epidemic years, and five so called sporadic years, in all, nineteen years in which yellow fever has been seen. In this enumeration, years in which even but one case of yellow fever has occurred in a resident, have been classified as sporadic years, viz., 1866, 1841 and 1837.

"Calmness of the days" constitutes a condition of most unfavorable influence upon the production of fevers generally, and of yellow fever especially. It is often associated with a cloudy sky, and with high heat and humidity. The cloudiness of the sky maintains the surface heat, by opposing an absolute barrier to radiation from the earth, while it does not wholly prevent the passage of the sun's rays through the veil of precipitated vapor suspended above. On account of the calmness presupposed, the air becomes densely laden with humidity given off from the surface, and filled with the accumulated effluvia of putrefaction. The conditions, moreover, are such as very greatly favor the over-

heating of the body, and the inhalation and swallowing of particulate atoms of putrescent efflavia, and, of course, the contagious emanations and excretions of individuals sick with yellow fever. This calmness of the air during the earlier periods of epidemics, and the associated sultriness, have been constantly noted by those who have made the causes of yellow fever a study. In speaking of the month of July, 1853, when the memorable epidemic of yellow fever prevailed in New Orleans, Barton says: "But what most distinguished the month in this respect (i. e. in relation to atmospheric motion), was the unusual number of calms noted in my register, amounting to twenty-six during the month, showing nearly one-fourth of the month the atmosphere to be in a stagnant condition, hot, saturated, filthy. The gutters, twelve hours after a rain, were reeking and bubbling up with gaseous products, all highly inimical to animal life." The mortality of June had been 21 deaths, but in this month of July, they were 1,409. "The number of calm days in August were without a parallel in New Orleans, viz., *seventeen*, or at *sixty-eight* observations, evidence of a close, suffocating, inelastic atmosphere." The mortality for the month was 5,362, or five-eighths of the entire mortality by yellow fever for the year. In 1858 I predicted the great epidemic of yellow fever in Charleston, ten days before it began, in a conversation with Dr. Wm. T. Wragg, from observations of the almost absolute calmness of the days and especially of the nights, during the first two weeks of August.

Calmness of the nights acts in the production of yellow fever, like calmness of the days, but with greatly increased efficiency. The humidity becomes excessive, very commonly amounting to absolute saturation about 2 A. M. The heat acquired by the earth and by the walls of buildings is retained in consequence of the exaltation of the humidity, which, as has been already explained, very greatly retards the cooling of the surface by radiation. In those flat cities where yellow fever so often appears, not even a sidelong current is observable, and the stratum of air which was in contact with the soil at 8 or 9 P. M., remains absolutely unmoved, and hour by hour becomes more and more impregnated with the effluvia of putrefaction and the emanations from the bodies of the sick. These conditions are raised to their highest term, to an intensity, indeed, which I have never been able to contemplate without a shudder, when such a

calm night in August or September is also *cloudy*. It is curious to observe how often these calm, cloudy nights succeed calm, fair days, in the months spoken of. The clouds appear towards evening, perhaps a very gentle sprinkling of rain falls, but usually does not, and by their interposition between the heated earth and the sky, totally prevent any cooling of the earth's surface or of the things upon it. The black sky hangs like a funereal pall, ready to envelop the devoted city. The sleeper tosses all night in the intolerable, sultry, vapor-laden air, and rises exhausted next morning, to undergo similar torture for several consecutive nights. It is not long before his system is unable to resist the influence of the septigenous matters which everywhere accumulate in this still and deadly calm of the night.

For many years I have endeavored to obtain figures expressive of the "calmness of the nights," one of the fundamental conditions of yellow fever.

No record has ever been kept in Charleston of this important meteorological element, though it is now obtainable from the registrations of the Signal Service, but only for a few years past, too short a term for decisive comparison.

I would have presented these figures, which are comprised in a record of the number of miles traveled by the wind from sunset to sunrise, but after application to the central office have not yet received them.

To determine by figures, however, the relations between calmness of the nights and the origin of yellow fever in Charleston, I was obliged to have recourse to a method based upon the known relations of the dew point at sunrise to the minimum of the register thermometer during the previous night. The relations of these two indications to each other are closely watched in England, it is said, by gardeners, who are able from a knowledge of the humidity at nightfall, to predict the minimum temperature to be reached before sunrise next morning, and so guard their plants from frost.

The method I have alluded to above, may be thus described. For long periods of time, the dew point of early morning is a little less than the minimum temperature, in the summer months. Thus, comparing the two figures, on the basis of computation of all recorded years up to 1857, in Charleston, we have the following:

	Aug.	Sept.	Oct.
Mean monthly minimum Reg. Thermometer	74 24	69.58	58.94
Mean dew point at Sunrise and conjointly for the three months.	74.29	68.73	57.84

and conjointly for the three months,

Mean minimum of the Reg. Thermometer	67.59.
Mean dew point at Sunrise..	66.95.

There is a marked disposition towards a declension of the night temperature to the dew point, for long periods of time, during these three months, in which we have seen calms to be characteristically prevalent. Each year, however, varies considerably in these respects, so that we find, for seasons and months, very varying degrees of approximation between the two records. The significance of these variations from the mean condition of very close approximation, especially in August, is what concerns us here.

If the dew point of the early morning be found to exceed the minimum temperature of the past night, then the temperature of the air must have increased after the thermometer had reached its lowest figure, which it could not have done had the air been calm; elevation of temperature must have been induced by the incursion of currents of air; superiority of the dew point to the minimum temperature, necessarily, therefore, signifies *wind* during the night, and an interruption of the calmness, which is more or less in proportion to the difference in the reading of the two instruments.

On the other hand, since the *evening dew point* is normally higher than that of the morning, and also above the minimum night temperature, for the months under consideration, it follows that when the dew point at sunrise is notably below the minimum night temperature, colder and drier air must have been introduced laterally, and this again signifies wind, and an interruption of the calmness, approximately proportional to the variation between the figures.

Superior as well as inferior variations of the dew point at sunrise from the minimum of the night temperature, equally signify the incursion of wind during the night, and an interference with the prevalent calmness.

If, now, we estimate the amount of this differential variation for each of the 92 days of the yellow fever season in Charleston, and for all the recorded years (up to 1857), by subtracting the fig-

ures from each other, but considering only the absolute number of degrees of variation, which signify wind in proportion to their extent whether the dew points have been higher than the minimum temperature, or the reverse, we obtain a series of figures from which we may compute the monthly and seasonal means of variations of the dew point at sunrise from the minimum night temperature, as expressive of the degrees of the windiness of the nights. The closer the approximation between the figures, the calmer the nights, in general, must have been, and the more extensive the variation, the windier or less calm. Arranging these figures incrementally in accordance with the system of investigation I have applied to the Charleston records, we have the following table:

Table T, showing the increments of the mean variations of the dew point at sunrise, from the mean minima of the register thermometer, calculated for the months of August, September and October conjointly, and for all the recorded years up to 1857:

Years	Variation.	Hygienic Annotation.	Years	Variation	Hygienic Annotation.
1848	4.79	Healthy.	1847	3.77	....
1853	4.52	Healthy.	1845	3.67	....
1851	4.48	Healthy.	1856	3 62	....
1849	4.39	....	1854	3.51	....
1857	4.35	....	1855	3.37	....
1846	4.30	....	1852	3.11	Yellow Fever.
1850	4.29	....			

The maxima, showing the most windy nights, indicate healthy seasons. The minimum, indeed the three minima except 1855, show the greatest epidemics which had ever prevailed in Charleston. The associate table of the means is subjoined:

Table U, showing the progression of the means for Table T:

Yellow Fever Years.	Healthy Years.
Mean....................................3 80	Mean....................................4.15

The progression is regular, and corroborates the indications of the preceding table. *Windiness of the nights, therefore, as indicated in the variations above tabulated, and for the yellow fever season in Charleston, is a primary agent in the prevention of yellow fever.*

I also present a pair of similar tables, in which September and October are considered together, to show that even by leaving out that month, which is naturally the calmest, the influ-

ence of calmness of the nights in the generation of yellow fever is so powerful, that the figures will give us identical results.

Table V, showing the increments of the mean variations of the dew point at sunrise from the minima of the register thermometer, calculated for all the years recorded up to 1857, and for the months of September and October conjointly:

Years.	Variation.	Hygienic Annotation.	Years.	Variation.	Hygienic Annotation.
1848	5.52	Healthy.	1845	4.65	....
1849	5.37	....	1847	4.62	....
1851	5.32	....	1856	4.10	....
1853	5.29	....	1855	3.95	....
1850	5.16	....	1854	3.72	Yellow Fever.
1857	5.12	....	1852	3.14	Yellow Fever.
1846	5.11	....	....	....	....

The maximum indicates a healthy year, and the minima yellow fever epidemics. The companion table is subjoined.

Table W, showing the progression of the means for Table V:

Yellow Fever Year.	Healthy Year.
Mean.....................................4.29	Mean.....................................4.95

The progression is regular, and confirms the indications of the previous table. For September and October, considered conjointly, we find that the windiness of the nights, as decided by the above variations, *is a primary agent in the prevention of yellow fever in Charleston.*

As the figures upon which these tables are based were procured by me in person, by substracting them from each other for every day of 1,196 days involved, directly from the official records of the City Registrar, it is obviously impossible for me to present the years since 1857, without a personal visit to Charleston. The method I was obliged to invent and apply myself, as there are no records in Charleston of the force of the wind, or calmness of the nights prior to 1874, when a United States Signal Station was established there. This, consequently, was the only method left open to me, although very laborious. The tables given were made out in 1857.

Winds are the great equalizers of the earth's heat. It is by the circulation of the atmosphere that the heat of equatorial regions is borne northwards and southwards, and the cold of polar regions diffused in moderate degrees over the temperate and

torrid zones. The influence of winds upon climate is therefore very greatly pronounced, in proportion to their temperature, humidity, direction and velocity. At present, we are especially concerned in the effects of winds upon the temperature of the earth's surface, and with their velocity or force, in view of their power in sweeping away strata of the atmosphere which have become, from local causes, unduly humid and of excessive temperature, and abnormally charged by quiescence with noxious effluvia.

Winds from the polar regions cool the earth by convection, while warm winds from heated expanses, or from equatorial belts, cause a direct elevation of the surface temperature. The elevation or reduction of temperature thus effected is very great, adequate, indeed, to modify and even very materially control the action of all the agencies affecting the temperature of the surface already alluded to. In the absence of winds differing in direction, temperature, humidity, force and ozonicity, according to season and latitude, the characteristic meteorological vicissitudes would perpetually sway between extremes which would very severely strain the powers of animal and vegetable life. Besides its influence in moderating temperature by direct convection, the varying humidity of the wind exercises a very strong influence upon the soil temperature. When vapor discharged from a warm, moist surface is removed from contact with it, a renewed and concurrent evolution takes place, and the surface quickly cools by parting with the heat necessary to maintain the vapor it emits in the gaseous state. This is the theory of freezing water in the air pump, and the principle upon which all modern methods of artificial ice-making depends. When a wind not already charged with moisture blows across a moist surface, vapor constantly escapes into it and is borne away, and a very powerful cooling influence is exerted upon the soil. The amount of heat which is necessary, in the latent form, or that which is not recognizable by the thermometer, to vaporize a given weight of water, is nearly five times as great as that requisite to heat the same weight of water from the freezing point to that of vaporization. The vapor so formed, moreover, possesses twice as great a convective power as the air, for equal *volumes*, and more than three times as much for equal *weights*.

Evaporation, therefore, is very active in reducing the temperature of a moist soil surface. Its influence, as exerted by

wind, is a matter of familiar thought in scientific agriculture. The removal of water by subsoil drainage at once exalts the heat of the surface by preventing this constant refrigerating process, and so quickens the germination and growth of plants. The effects produced by winds in this way are thus determined by their temperature and the amount of moisture they contain, and consequently by their direction at given seasons.

Let us proceed now to examine the *direction* of the winds with reference to the etiology of yellow fever in Charleston. Dividing the winds which blow at that city into two groups, viz., those which blow from the sea and along the coast, and those which blow from the land, as the coast line of the State trends nearly from northeast to southwest, we have in the category of sea winds the northeasterly, easterly, southeasterly, southerly and southwesterly winds. I present the following table of these winds.

All the years obtainable are placed in the tables, excepting those years in which the *number of times* the wind was noted as blowing from the several points of the compass, instead of the *number of days* which their general direction was noted, as the figures are not comparable with those of the latter designation. The figures given are the *mean* of the observations at sunrise, and at 4 P. M.

Table X, showing the increments of the number of days in August, September and October conjointly, on which the wind blew from the northeast, east, southeast, south and southwest, or from the sea and along the coast, in thirty years. The cholera year (1836) is omitted:

Years.	No. Days	Hygienic Annotation.	Years.	No. Days	Hygienic Annotation.
1853	108.5	Healthy.	1841	90	....
1866	104.5	....	1858	88	....
1855	103.5	....	1844	86	....
1846	103.5	....	1839	85	....
1852	102	....	1838	85	....
1851	101.5	....	1837	84	....
1848	101.5	....	1840	84	....
1850	100	....	1843	83	....
1847	99.5	....	1857	82.5	....
1854	98.5	....	1833	81	....
1856	97	....	1868	79	....
1835	96	....	1869	76.5	....
1849	95	....	1842	74	....
1832	93	....	1865	69.5	....
1845	91	....	1834	68	Yellow Fever.

The maximum indicates a healthy year, and the minimum a yellow fever year. Below is the companion table of the means.

Tably Y showing the means for table W.

Yellow Fever Years.	Healthy Years.
Mean.....89.5	Mean.....91.2

The progression is confirmatory of the indications of the previous table, and establishes the theoretical assumption that the *prevalence of winds from the designated points of the compass in Charleston, is a primary agency in the prevention of yellow fever.* Possibly the southwest winds should not have been included in the category of sea winds, but as a coast wind, its general qualities seem to be those of both a sea and land wind, and I have computed its figure with the rest, as they are not sufficiently marked to invalidate the significance of the other winds.

The sea winds prevail in Charleston in September and October, especially. Their effect is exerted not only upon the soil and putrefactive foci, but likewise upon man. By their lower temperature and humidity they cool the surface of the human body, at once by convection and by evaporation. They prevail mostly during the day, and are due to the indraught consequent upon solar heating of the interior of the continent These winds are probably effective, moreover, not only in aiding the ascending diurnal currents in the evection of miasmatic effluvia, but also in directly destroying such matter, through the ozone with which sea air is moderately charged.

Let us turn in the next place to an examination of the records of the past five years for the eleven cities, with reference to the yellow fever of 1878. I subjoin a table showing the monthly velocity of the winds for each of the four summer months, with monthly and seasonal means, for each of the five years, viz., 1874 to 1878, and each of the eleven cities. The figures denote the number of miles traveled by the wind in twenty-four hours:

ST. LOUIS.						LOUISVILLE.					
Year.	July.	Aug.	Sept.	Oct.	Mean	Year.	July.	Aug.	Sept.	Oct.	Mean
1878	189.3	173 4	218.6	279.9	215.3	1878	141.7	142 7	160.7	183.5	157.1
1877	199.8	179.3	158.7	219.5	189.3	1877	166.9	136.9	121.9	150.7	144.1
1876	193.8	176.9	169 4	245.7	196.4	1876	135.5	106.9	127.4	173.5	135.8
1875	175.1	199.1	199.6	268.1	210.5	1875	100.7	87.1	117.5	168.5	118.4
1874	206.7	189.7	184.2	195.1	193.9	1874	115.5	118.2	86.4	131.2	112.8
Mean	192.9	183.7	186.1	241.7	201 3	Mean	132.1	118.3	122.8	161.5	133.6

CAIRO.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	103.1	123.2	172.9	202.6	150.4
1877	168.8	130.2	129.7	195.6	156.3
1876	116.2	119.2	128.7	159.2	130.8
1875	127.7	119.8	101.4	163.9	128.2
1874	116.5	113.3	104.5	120.9	113.8
Mean	126.5	121.1	127.4	168.6	135.8

MEMPHIS.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	105.0	94.0	125.2	146.1	117.6
1877	116.7	95.7	102.5	115.8	107.7
1876	108.5	91.3	105.6	110.2	103.9
1875	108.4	87.2	101 2	125.2	105.5
1874	93.3	7 .1	48.8	62.2	70.1
Mean	106.4	88.9	96.6	111.9	101.0

VICKSBURG.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	88.29	87.06	136.5	145.5	114.3
1877	45 76	92.73	146 0	140.2	106.2
1876	90.9	74.28	60.8	100.4	81.6
1875	114.3	71.2	92.9	111.7	97.5
1874	73.8	74.3	73.1	72.5	73.4
Mean	82.6	79.9	101.9	114.1	94.6

GALVESTON.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	155.9	153.6	219.4	228.2	189 3
1877	167.1	142 2	222.7	224 6	189.1
1876	158.8	145 9	177.7	222.0	176.1
1875	213.4	195.8	308.1	230.7	237.0
1874	190 3	183.4	220.7	216 5	202.7
Mean	177.1	164 2	229.7	224.4	198.8

NEW ORLEANS.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	12 .5	148.0	175.5	183.2	157.3
1877	144.3	138.9	193.1	236.3	178 1
1876	125.7	147.7	140.2	165.3	144.7
1875	130.8	135.6	213.3	171 1	162.7
1874	167.0	160.2	178.7	172.9	169.9
Mean	138.1	146 1	180.2	185 7	162 5

MOBILE.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	118.8	121.8	157.6	167.5	141.4
1877	155.3	116.1	158 9	181.9	153.0
1876	137 3	134.0	104.2	169.5	136.2
1875	106.7	89.3	151.0	123.4	117.6
1874	133 9	146.9	134.7	142.8	139.6
Mean	130 4	121.6	141.3	157.0	137.6

CHARLESTON.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	227.3	176.6	216.5	180.3	200.3
1877	188.8	169.8	230.8	203.2	198.1
1876	194.7	145.9	175.5	202.9	179.7
1875	209.1	182.4	199.9	159.1	187.6
1874	172.0	166.8	178.3	165.8	170.7
Mean	198.4	168.3	200.2	182.3	187.3

NORFOLK.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	191.8	151.7	177.9	178.8	175.0
1877	192.4	149.8	167.4	188.2	174.4
1876	172.9	133.9	177.1	190.2	168.5
1875	172.6	184.4	181.4	187.0	181.3
1874	191.6	161 2	141.2	171.9	166.5
Mean	184.5	156.2	169.0	183.2	173.1

PHILADELPHIA.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	216.5	185.9	218.7	273.6	223.7
1877	291.1	190.3	204.2	245.1	232.7
1876	211.4	178.3	268 5	238.6	224.2
1875	202.3	208.9	210.7	225.5	211.8
1874	222.5	204.7	165.2	216.0	202.1
Mean	228.8	193.6	213.5	239.8	218 9

The average seasonal means for the three Atlantic cities, is 193.1; that for the Valley cities, 133.3; and that for the Gulf cities, 166.3. The Valley cities are therefore the least windy; the Gulf cities more so, and the Atlantic cities the windiest of all. This accords exactly with what we have found for the number of calms, which are of course expressed in the reverse direction, the valley cities being more than three times as calm as the Gulf cities, and these again more subject to calms than the Atlantic cities. Along the Mississippi river, we find the least windiness and greatest proclivity to stagnation of the air; this region is consequently more liable to suffer from epidemics taking their origin in atmospheric stagnancy, than the cities on the Gulf, and these again more apt to do so than the Atlantic sea board cities. This is one of the great meteorological reasons why these Valley cities and two of the Gulf cities suffered from the yellow fever in 1878, while the Atlantic cities did not. It was *natural* that they should have done so, *ceteris paribus*.

Of all the cities, Vicksburg is the least windy. The figure for Memphis comes next, being but little higher, and next to this in order, Louisville, Cairo and St. Louis.

Philadelphia is the windiest, and therefore the healthiest of the three Atlantic cities; Charleston less so, and Norfolk the least windy of the group.

Mobile is the least windy of the three Gulf cities; New Orleans more windy than Mobile, and Galveston, the city in which *yellow fever did not prevail in 1878*, while it prevailed to some extent in Mobile, and heavily in New Orleans, is the windiest city of the three. Indeed, the mean figure for Galveston is 198.8, which makes it the windiest city of the eleven, excepting Philadelphia, whose figure is 218.9. We have already seen that calms are less frequent in Galveston than any other of the eleven cities, and that city must therefore be less liable to epidemics of yellow fever than any other city of the Gulf coast, Lower Mississippi Valley or Southern Atlantic Seaboard. No yellow fever has existed in Galveston since 1865.

We note in every one of the cities, except New Orleans and Galveston, a marked progression of the mean annual windiness, from 1874, inclusively, to 1878, which was everywhere, except in the two cities named, *windier* than the average. A distinct progression of the yearly means in the same direction is likewise observable. This is due to the steady rise of temperature, from

1874 to 1878, all over the country, already noticed, and to the fact that 1878 was the hottest year of the five. The velocity of the wind is directly controlled by the heat of the earth's surface; and the winds noted are to a great extent those due to indraught of air from the ocean, to take the place of strata heated in the interior of the continent and rising away from the surface. Enhancement of seasonal temperature is, moreover, the immediate cause of greater windiness in various directions, as all currents of the atmosphere are dependent upon this prime cause, and are also mutually interdependent.

The season of 1878 was therefore very windy, in general, because it was unusually hot.

Taking, now, the months in which yellow fever made its appearance and prevailed in seven of the cities in 1878, we find:

In St. Louis, the month of August was less windy than its mean, the first cases occurring in that month. September and October were greatly windier than their mean, and to this is doubtless due the very limited number of cases of fever which occurred, and the remarkable healthiness of St. Louis in general. This city is *the windiest city of any of the eleven, except Philadelphia, and ought therefore to be free from danger from diseases induced by aerial stagnancy.* The seasonal mean for St. Louis is 201.3 miles; that of Philadelphia being 218.9; for Louisville, 133.6; for Cairo, 135.9, etc.

In Louisville, every month of 1878 was windier than its mean, and all, except July, windier than the same month for five years previously. In this we find an explanation, likewise, of the fortunate limitation of the local outbreak which occurred in September and October.

In Cairo, the condition was almost exactly the same as in Louisville; July was less windy than usual, but August, September and October windier than their means. The months of September and October were windier than any months of their names for five years. Had it been otherwise, as these were the months in which the yellow fever showed a very decided disposition to become epidemic in Cairo, the mortality would most probably have been much greater than it was.

In Memphis, July was less windy than usual, and August (94.0 miles) but little windier than its mean (88.9). September shows about the same figure (125.2) that we find for the month of July in New Orleans, in which the fever appeared in that city,

viz., 122.5, and October was of the same windiness as August, 1878, in New Orleans. All the figures are those with which epidemics are compatible.

In Vicksburg, the windiness was even less than in Memphis, and it was in this city that the yellow fever of 1878 was more fatal in proportion to the population than in any other; Vicksburg was *literally* decimated. The disease appeared in August, which was less windy than the previous month; its figures, 87.06, are lower than any to be found except for August, 1875, in Louisville, in any of the cities but Vicksburg itself and Memphis, both of which cities are naturally the least windy of the eleven, as we have seen. In September, the windiness was less than it was in New Orleans in August, while the epidemic was in full prevalence there, and in October it was still less windy than in August in New Orleans, and just about as windy as the same month in Memphis. The mean windiness of 1878 in Vicksburg was 114.3, and in Memphis 117.6, the season being nearly identical in this respect in these two cities.

In Mobile, we find a windiness for the season of 1878 of 141.4, the mean of five years being 137.6. In this city, therefore, 1878 was but very little more windy than its average, notwithstanding the universal tendency of the year to be more windy than usual on account of its greater heat. July was less windy than usual, and August just at its mean; the months of September and October were more windy than the average. The fever threatened to invade Mobile throughout the season, but was continually kept in check in September and October, by the increasing windiness, notwithstanding the fact that the temperature of every month of the season was unusually high, the rainfall of exactly the proper quantity for the generation of yellow fever, and the humidity of every month of the season greater than the average.

In New Orleans, we notice that yellow fever appeared and became distinctly epidemic in July, 1878, the *least windy month* in any of the *twenty* months whose figures are presented for that city. The following August was just about of the average windiness, while September, in which the epidemic culminated, was less windy than it commonly is, and so also was the month of October. In New Orleans, the season of 1878 was less windy than any of the five seasons except that of 1876, and of course less windy than its common average, in spite of the exaggerated heat, whose natural tendency is to create draught and windiness. A

mean windiness of less than five miles an hour such as prevailed in July, 1878, in New Orleans, is wholly inadequate in a city so closely built in its older portions, to the proper evection of humid and miasm-laden air.

The movement of the wind from sunset to sunrise, would have been of far greater interest in these considerations, than the figures at our disposal, which indeed include the nocturnal wind movement, but overmask it with the more conspicuous windiness of the day-light hours.

In Galveston, a city in which yellow fever did not prevail in 1878, we find a windiness in July, which although below the mean of the month for that very windy city, the least *calm* of any of the eleven, as we have seen, is nevertheless altogether higher than that for the same month, either in Mobile or New Orleans. (Mobile, 118.8; New Orleans, 122.5; Galveston 155.9.) In August, the figure (153.6) is still above that for the same month in either New Orleans or Mobile, though lower than its own monthly mean. In September, the daily movement was 219.4 miles, again lower than its own monthly mean, which is naturally very high in Galveston, but thirty per cent higher than in New Orleans, and fifty per cent higher than in Mobile. In October, the wind traveled 228.2 miles a day, a figure greater than the average of the month, even for Galveston, and so high a figure, although exceeded in 1875 in Galveston, that nothing approaching to it can be found in any of the months or years under consideration, in any city of the Mississippi Valley or Gulf Coast, *except St. Louis*. In 1878, therefore, Galveston was perfectly cleansed of miasmatic effluvia, and of overheated and vapor-laden air, both by day and by night, by the constant action of the perpetually blowing winds. It is to this, is conjunction, as we shall see, with the unusual prevalence of thunderstorms in 1878, that Galveston owes her immunity from yellow fever, and not to the efficiency of a quarantine barrier, as has been widely and dogmatically asserted, even by men who are wholly ignorant of the diseases and climatology of our country. To her insular and littoral position on a coast, across which the whole indraught of the great continent to the north of her must pass, to the hourly ventilation so effected, and the frequent agitation of the atmosphere by thunderstorms, as I shall show in its proper place, in conjunction with unusual cloudiness of the sky, *Galveston owes her good fortune in 1878*, in spite of her high, though not very un-

usual temperatures, and a rainfall and humidity of a grade exactly suited to the generation of yellow fever.

In Charleston there was no yellow fever in 1878. The temperatures were moderate, the number of fair days in July and August, when the highest temperature prevailed, was also above its mean, but in both September and October the fairness of the days was below the average. The rainfall was enormous; above its mean in July, nearly double its mean in August, and above its mean in September, being twenty-five per cent above the mean of the whole season for the four months conjointly; the humidity, never pronounced, being almost exactly at its mean for every month of the season. The windiness of July was 227.3 miles, greater than in any of the Atlantic cities; in August it was notably greater than its mean, and so likewise for the month of September, in each of these months rivalling the windiness of Philadelpha, and exceeding not only its proper mean, but the monthly figures of Norfolk. In October, the windiness was just about its mean, but still greater than that of the same month in Mobile or Norfolk. As in the case of Galveston, it is almost entirely to this unusual degree of windiness, in conjunction, likewise, with a diminished fairness and an unusual prevalence of thunderstorms, that Charleston owed her escape from the scourge which was devastating the land-locked cities of the West and of the humid alluvium of the great river and its tributaries.

In 1874 yellow fever prevailed in Charleston, with 40 deaths. In that year, the windiness was much *lower* than its mean in July, below its mean in August, and very notably below its mean in both September and October. The mean of the four months was consequently markedly below its quinquennial mean. This is in accordance with what has been shown. In 1876, there was also yellow fever in Charleston, viz., 10 deaths in September, 18 in October, and 2 in November, making a total of 30 for the season. The windiness of July was below its mean, that for August greatly so, that for September, the month in which the cases first occurred, less than any other figure for five years, while that for October was equal to that of the healthy year of 1877, and ten per cent above its mean. The disease numbered but 18 victims in this month, and was very soon brought to a termination.

There was no yellow fever in Norfolk in 1878. The seasonal figure for that year, we find to have been above its mean. That for July was decidedly so; for August, but a few figures below

its mean; for September, markedly above its mean, and for October, very near its mean. Altogether, the season was the most windy of the five years, excepting 1875.

THUNDERSTORMS.

Thunderstorms are powerfullly conducive to health in three ways:

1st. By the influence of the strong winds which always accompany a typical thunderstorm, in removing miasmatic effluvia and humid air.

2d. By the cooling of the earth's surface, and the refrigeration of the animal body by these winds, which are nearly always of lower temperature and humidity than the strata of the atmosphere which they sweep away.

3d. By the neutralization of miasms and stimulation of the economy affected by the ozone which is characteristically abundant during thunderstorms, and in the air which rests upon the surface after their occurrence. Being thus strongly in opposition to heat, humidity, stagnation of the air, and miasmatic effluvia, thunderstorms are directly antagonistic to all diseases produced by such conditions, and to yellow fever in particular, as the most marked and dangerous of them all.

Thunderstorms are most frequent in the warm months, inasmuch as evaporation is then most active, and by shifting currents of the wind, warm and vapor-laden strata of the atmosphere are more apt to be brought into contact and admixture with colder and drier masses; whence all the characteristic phenomena of electrical excitement, precipitation of vapor in the form of rain, and violent atmospheric commotion proceed. Thunderstorms are consequently most often observed in the neighborhood of large masses of water of unusually high temperature, such as inland seas, the Gulf of Mexico, and the seas of archipelagoes, according to Arago. This frequency does not pertain to the aqueous surface itself, but to the littoral regions, and diminishes towards the interior of the continents. There are spots upon the ocean as well as the dry land where it probably never thunders; thunder is but seldom heard in the desert of Sahara, and in Egypt thunderstorms occur but three or four times in the year, and are limited moreover to the seashore and

banks of the Nile. In this country, thunderstorms are most frequent in the immediate contiguity of the Gulf of Mexico, less so on the Atlantic coast, owing to the cooler temperature of the return or polar current of the ocean which sweeps southward along the eastern shore of the United States to the west of the Gulf stream, and still less frequent in the Valley of the Mississippi, and here also the further we go north along this river. These laws of thunderstorms prevail all over the world, and a strict parallelism also obtains for the frequency with which these atmospheric phenomena occur in the several months of the warmer season. Thus, the total number of thunderstorms in each month, for the four years, 1855--1854, as observed by Simonin and Boeckel at Nancy and Strasburg, was as follows:

Jan.	Feb.	M'ch	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
0	0	1	4	13	17	16	17	2	1	0	0

The maxima are reached in France, in June, July and August, whence a very rapid declension in September and October is observable.

The following table from the Charleston records show the number of days on which thunderstorms occurred during the warm months—estimated from thirteen years—viz., 1845--1857.

June.	July.	August.	September.	October.
4.2	6.6	5.1	1.8	0.7

July is seen to be the month of the maximum prevalence of thunderstorms, and in the French table, a very rapid diminution is noticeable for September; and in October there is not one thunderstorm on an average.

I also insert the following figures kindly furnished me by Dr. Henry A. Desaussure, of Charleston, from his personal records, showing the mean number of days upon which thunder was heard or lightning seen in Charleston during the ten years, (1842--1851)in each of the six warmer months.

June.	July.	August.	September.	October.	November.
6.5	10.5	10.1	3.8	0.9	0.3

The maximum is in July as before, and from August to September the same remarkable and almost precipitous descent already observed is again noticeable.

Taking now the total of all thunderstorms recorded under the Signal Service, in each of the five years and eleven cities conjointly, we have the following:

July.	August.	September.	October.
182.19	146.06	39.23	24.98

The maximum is again in July. In August the figure is distinctly lower, and the sudden descent already observed in the previous tables from August to September and October, is again very distinct.

Those months, consequently, in which yellow fever and malarial fevers begin to appear, and reach their highest degree of prevalence, viz., August, September and October, show a characteristic diminution in the frequency of thunderstorms, by the exaggerated diminution of the figures as compared with the previous months.

From what has been said, thunderstorms ought to be directly antagonistic to yellow fever. I, therefore, present the following :able of thunderstorms in Charleston, showing their relation to yellow fever.

Table Z, showing the increments of the number of thunderstorms in August, September and October conjointly, as computed for years prior to 1857, from the official records of Charleston, and for years since that time from the data furnished to the St. Louis Medical Society from Washington. (All the years obtainable are included.)

Years.	No. Storms.	Hygienic Annotation.	Years.	No. Storms.	Hygienic Annotation.
1850	16	Healthy.	1856	6	....
1845	14	Healthy.	1877	5.14	....
1855	11	Healthy.	1847	5	....
1853	10	Healthy.	1848	4	....
1854	10	....	1878	3.86	....
1876	8.13	....	1852	3	....
1849	8	....	1875	2	....
1851	7	....	1846	0	....
1857	6	....	1874	0	....

The maxima indicate healthy years; the years 1845 and 1850 were remarkable for their constant electrical excitement. In 1850

the break-bone fever, a catarrhal disease which is naturally antagonistic to yellow fever, like all catarrhal diseases, as I have shown in an article published some years ago in the *Southern Jour. of the Med. Sci.* prevailed extensively. A season may be very windy, without thunderstorms; for, although thunderstorms pressuppose wind, the reverse by no means necessarily obtains. The season of 1874 was wholly devoid of thunderstorms in nine of the eleven cities; nevertheless, in two of these cities, viz., New Orleans and Galveston, the windiness was above the average. Winds, therefore, in exceptional cases, may prevail extensively enough to preserve health, in the absence of thunderstorms. It is for this reason that we do not find a yellow fever year necessarily at the bottom of the foregoing table; for, although I have placed the year 1874, a yellow fever year at the bottom—1846, a healthy year may have been equally placed there, as there were no thunderstorms in either of these years. But to make the effects of thunderstorms on yellow fever conspicuous, I subjoin the companion table of the means.

Table Z′, showing the progression of the means for table Z:

Yellow Fever Years.	Healthy Years.
Mean, 5.87	Mean, 7.09

The progression is regular, and corroborates the indications of the previous table. *Thunderstorms, therefore, are a primary agent in the prevention of yellow fever*, although in their absence yellow fever does not necessarily occur, if wind due to other influences prevails, adequate to the evection of humid, heated, and miasm-laden air.

The relation of thunderstorms to the ozonicity of the air is well worthy of a far closer study than it is possible for us to make at this time. It is proper, however, to say a few words on this very important subject.

Ozone was discovered by Schönbein, in 1847, and in 1854 more fully investigated by Schiefferdecker, of Königsberg, and Scoutteten, of Metz. Its nature is not exactly ascertained, but it is generally regarded either as a monatomic condition of oxygen, or as a positively electrified form of that substance. Its chemical characteristic is a most intense oxydizing power. It is very doubtful, indeed, if oxygen is ever active in producing oxidation except as ozone, even in the most transitory chemical reactions.

When concentrated, ozone is rapidly fatal to animal life, as I have often demonstrated, and immediately oxydizes all metals except gold and platinum, even in the cold and dark, and in the absence of water. It combines instantaneously with all organic compounds, and so converts them into new bodies; indeed, the oxydizing power even of chlorine, as shown in bleaching, is now regarded as due to the formation of ozone. It is emitted from a mixture of permanganate of potassa and sulphuric acid in large quantity and of highly intense grade, as well as from various other mixtures. When mingled with air containing odorous substances, whether derived from the vegetable or animal kingdom, of the nature of ordinary olfactive effluvia, or due to putrefaction, ozone immediately combines with them, and totally converts them into new and simpler matters. These facts were thoroughly proved by Schönbein and Scoutteten, and I have myself determined their correctness by employing an ozoniferous mixture in the dissecting room, in privies and private apartments, with most unqualified results of a similar character.

Ozone is a great natural agent, and is one of the constant and indispensable elements of the atmosphere, from which it is probably never absent, except very near the earth, where, if it exists in small quantity, it may become exhausted in the surface strata. For similar reasons ozone is usually absent in the interior of dwellings, courts, wards of hospitals or other confined places where oxydizable miasmata abound, in consequence of its rapid combination with all matters of the kind.

Ozone is naturally formed during thunderstorms, as it is artificially, by the passage of a spark from the prime conductor of an electrical machine. The oxygen of the air becomes electrified at the moment of the discharge of the thunderbolt, and in small proportion converted into ozone. Ozone formed in this way is recognized by its smell, which resembles that of sulphur. This strong odor is implied in the name of the substance, and is very often observed during thunderstorms, and especially in the immediate neighborhood of discharges of electricity from the sky. It is occasionally strong enough, says Arago, to take away the breath.

Ozone is thus produced among the clouds is vast quantities, although the air seldom contains more than a few parts in a hundred thousand. When generated in the upper regions of the atmosphere, it is widely disseminated by the wind, eventually

reaching the earth. Experiment shows that ozone occasionally descends to the earth in great abundance very soon after its formation above. This is perhaps due to the incursion of colder currents of air. Ozone is formed during the evaporation of saline solutions, and is consequently present in winds traversing the ocean and in the air which passes through forests whose leaves are in full activity; it is also formed by induction, without actual discharges of electricity, in clouds, and perhaps on the surface of terrestrial objects. It is, moreover, formed in all porous soils containing oxydizable matter, and its appearance under such circumstances is the cause of the transformation of ammonia into nitric acid, a process of vast natural proportions, termed nitrification, which must be held to underlie the fertility of the soil.

Finally, the blood itself contains oxygen in the form of ozone, and is thus rendered competent to effect oxidations which do not occur in the atmosphere, unless ozone be present. It is highly probable that a moderate degree of ozonicity of the air is grateful and advantageous to animal life, and indeed that by a process of acclimation the ozonicity of the blood acquires, in time, a grade which is strictly complemental to the ozonicity of the atmosphere at any given place. When abnormally abundant in the atmosphere, ozone begets catarrhal affections on the basis of a previously existing general excitement of the nature of what we call "gastric embarrassment" or "biliousness"—acute congestion of the lungs, and simple inflammations of the air passages and exposed mucous membranes. I have found that an antagonism exists between yellow fever and catarrhal diseases, which can only be explained by the destructive agency of ozone upon the effluvia of putrefaction and the depression of the animal functions consequent upon a deficiency or absence of ozone in the atmosphere. It is asserted that ozone is absent in the atmosphere during the prevalence of epidemics of cholera. I have myself, on repeated occasions, determined its absence in the air, especially at night, during the existence of epidemics of yellow fever, both in Charleston and New Orleans.

Ozone must be regarded as the great natural agent by whose oxidative power the host of noxious effluvia given forth into the air and water from decomposing animal and vegetable matters all over the earth's surface are destroyed—that is, reduced to simpler forms in which oxidation is complete, and which are thereby rendered competent to take part in the processes of veg-

etable life, and so to begin anew the circle of compositive action upon which vital activity is based.

Let us now proceed to examine the data in our possession with reference to the prevalence of thunderstorms in 1878. Appended is a table similar to those already presented, showing the monthly number of thunderstorms in each of the five seasons and eleven cities, with the means and totals:

ST. LOUIS.					
Year.	July.	Aug.	Sept.	Oct.	Total.
1878	3.69	3.86	1.00	1.00	9.55
1877	4.00	4.70	1.28	1.00	10.98
1876	1.00	2.43	2.57	1.00	7.00
1875	2.00	0.00	0.00	1.00	3.00
1874	1.57	1.00	0.60	0.00	2.57
Mean	2.45	2.40	9.97	0.80	4.82

LOUISVILLE.					
Year.	July.	Aug.	Sept.	Oct.	Total.
1878	6.00	3 86	1.00	2.00	12.86
1877	5.00	1.86	2.14	1.00	10.00
1876	0.00	2.71	0.28	0.43	3.42
1875	0.00	0.00	0.00	3.14	3.14
1874	0.00	0.00	0.00	0.00	0.00
Mean	2.20	1.69	0.68	1.31	5.88

CAIRO.					
Year.	July.	Aug.	Sept.	Oct.	Total.
1878	6.00	6.86	1.00	0.00	13.86
1877	2.00	1.86	1.14	0.57	5.57
1876	0.00	0.00	1.00	0.00	1.00
1875	1.00	0.00	0.00	0.00	1.00
1874	0.00	0.00	0.00	0.00	0.00
Mean	1.80	1.74	0.63	0.11	4 29

MEMPHIS.					
Year.	July.	Aug.	Sept.	Oct.	Total.
1878	1.00	0.00	0.00	0.00	1.00
1877	1.43	2.57	2 00	0 00	6.00
1876	3 14	2.85	0.28	1.00	7.27
1875	14.43	2.43	0.57	2.14	19.57
1874	0.00	0 00	0.00	0.00	0.00
Mean	4.00	1.57	0.57	0.63	6.77

VICKSBURG.					
Year.	July.	Aug.	Sept.	Oct.	Total.
1878	13.14	3.43	0.00	0.00	16.57
1877	1.00	0.00	0.00	0.00	1.00
1876	2.00	4.71	1.28	0.00	8.00
1875	7.14	3.00	1.00	0.00	11.14
1874	0.00	0.00	0.00	0.00	0.00
Mean	4.66	2.23	0.46	0.00	7.34

GALVESTON.					
Year.	July.	Aug.	Sept.	Oct.	Total.
1878	5.57	9.38	0.00	0.00	14.95
1877	8.43	8.43	4.14	5.14	26.14
1876	4.28	3.71	0.00	0 00	7.99
1875	1.00	0.00	0.00	1 00	2.00
1874	0.00	0.00	0.00	0.00	0.00
Mean	3.86	4.30	0.83	1.23	10.22

NEW ORLEANS.					
Year.	July.	Aug.	Sept.	Oct.	Total.
1878	1.57	1.43	0.00	0 00	3.00
1877	4.43	1.57	2.00	1.14	9.14
1876	4.00	0.00	0.00	0.00	4.00
1875	1.00	0.00	0.00	0.00	1.00
1874	0.00	0.00	0.00	0.00	0.00
Mean	2.20	0.60	0.40	0.23	3.43

MOBILE.					
Year.	July.	Aug.	Sept.	Oct.	Total.
1878	10.14	6.43	4 00	0.00	20.57
1877	0.00	1.85	0.14	1.00	3.00
1876	13.14	20.28	1.57	0.00	34.99
1875	5.43	6.00	2.00	1.14	14.57
1874	0.00	3.00	0 00	0.00	3.00
Mean	5.74	7.51	1.54	0.43	15.23

CHARLESTON.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	2.24	3.86	0.00	0.00	6.10
1877	3.86	3.00	2.14	0.00	9.00
1876	5.14	6.56	1.57	0.00	13.27
1875	2.43	2.0	0.00	0.00	4.43
1874	0.00	0.00	0.00	0.00	0.00
Mean	2.73	3.08	0.74	0.00	6.54

NORFOLK.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	2.57	3.43	3.00	0.00	9.00
1877	4.00	0.00	8.00	0.00	4.00
1876	6.00	1.00	0.00	0.00	7.00
1875	7 00	9.00	0.00	0.00	16.00
1874	0.00	0.00	0.00	0.00	0.00
Mean	3.91	2.69	0.60	0.00	7.20

PHILADELPHIA.

Year.	July.	Aug.	Sept.	Oct.	Total.
1878	7.43	3.43	1.00	0.00	11.86
1877	4.00	0.86	0.14	1.00	6.00
1876	1.28	2.71	0.28	0.00	4.27
1875	1.71	0.00	0 71	0.28	2.71
1874	0 00	0.60	0.00	0.00	0.00
Mean	2.88	1.40	0.43	0.26	4.97

We note, in the first place, that the mean seasonal prevalence of thunderstorms in the Gulf cities is 9.09; that of the cities of the Mississippi Valley, 5.82; and of the Atlantic cities, 5.74. In this we have a confirmation of the general law, that thunderstorms are more frequent along the borders of warm masses of water like the Gulf of Mexico, than in the interior of continents. The general decrease from Vicksburg towards Cairo will be observed. St. Louis, Cairo and Louisville show figures not far removed from each other.

The very remarkable deficiency of thunderstorms in 1874, in every one of the cities, is worthy of attention. In only two of the cities were there any thunderstorms at all, viz., in St. Louis, 2.57, and in Mobile, 3; all of these occurring in July and August. In 1874 yellow fever prevailed to a slight degree in New Orleans, where there were no thunderstorms, and in Charleston, also, where there were likewise none at all. This was the year in which it prevailed in the shipping at Pensacola, and disastrously at Shreveport.

In St. Louis, in 1878, we note one thunderstorm in September, and one in August. A general movement is discernible in the frequency of these storms from 1874 towards 1878, in all the cities taken together. Thus, if we sum up the entire number of thunderstorms occurring in each of the five years in all the cities taken together, we have the following:

Years	1874	1875	1876	1877	1878
Totals	5.57	78.56	90.23	90.83	119.32

The movement is perfectly regular, and accords with that of the temperature, which we have seen progresses in like manner, constituting the year 1878 the hottest of the five. As thunderstorms affect the hottest months, so do they likewise the hottest years, because the phenomena of evaporation upon which they depend are then most active. While, however, this greater frequency qualifies the whole area of the United States south of Philadelphia in the *sum* of the storms of all the cities, very remarkable variations in this frequency are to be observed in individual cities—thus:

In Louisville, in 1878, there were two thunderstorms in October—very unusual occurrences—and the prevalent yellow fever which began in the week ending September 28th, was arrested after their occurrence, in the week ending October 12th.

In Cairo there were no thunderstorms in October, and the yellow fever continued until after frost.

In Memphis but *one* thunderstorm occurred in the season, and this one, just one month, (viz., week ending July 13th), before the outbreak of the yellow fever. *Not a single thunderstorm occurred in that city during the epidemic.*

In Vicksburg there were very numerous thunderstorms in July, of which nine occurred in the week ending July 13th. In August one storm is noted in the week ending August 3d; none the following week, in which the disease was developed, if not yet declared; two in the week ending August 17th, and one the following week; but from that date, viz., August 24th, to the end of the season, the period of the devastating epidemic, *not a solitary thunderstorm occurred.*

In New Orleans there were no thunderstorms during the first three weeks of July, the period in which the epidemic was developed and established. One storm occurred in the last week in July, and one in the first week in August, and with the exception of one in the last week of August, *there were no others for the balance of the season.* The epidemic appeared in July, which, al-

though the hottest month, was nevertheless perfectly free from thunderstorms until nearly its close; but *one storm* appeared to break in upon the general stagnancy of the season.

In Mobile we find an unusual prevalence of thunderstorms for the first three months of the season, with freedom from anything like an epidemic. In October, however, the yellow fever became very distinctly epidemic, and not a thunderstorm is noted for that particular month.

In Galveston thunderstorms were unusually frequent in July and August, the formative months, be it recollected, for yellow fever. In September and October none are noted, but I have already shown that the windiness of the entire season was very remarkable in Galveston. To the constant renewal of the air in the hot months by thunderstorms, in conjunction with a high degree of windiness for the balance of the season, Galveston undoubtedly owed her escape in 1878.

Similar remarks apply to Charleston and to Norfolk, in both of which cities we have observed an unusual windiness, especially in September and October. A season is sure to be healthy when thunderstorms are frequent in July and August, and when, from natural causes dependent upon the decline of temperature and change of direction of the winds, in August, as I have shown, these majestic atmospheric phenomena begin to disappear, ventilation is nevertheless maintained by the steady and increasing movement of the winds.

ATMOSPHERIC PRESSURE.

Oscillations of the barometer, due to the changes in the weight of the column of air which rests upon the mercury in the cistern of the instrument, are produced by all causes which affect the density of the atmosphere. The principal of these are the temperature of the air, its humidity, and the phenomena accompanying precipitation.

Diminution of temperature, by increasing the density of the air, causes the mercury to rise, and conversely, for elevation of temperature. The barometer becomes in this way a sort of thermoscope, inasmuch as its annual variations are principally affected by the changing temperature of the seasons. The annual maximum pressure consequently occurs in the coldest month, January, and the minimum in July, which is the hottest. This

annual variation finds a parallel in the *diurnal* variation, which is controlled likewise by the changing temperature of the twenty-four hours. The humidity of the air operates in an exactly reverse direction upon both the annual and daily variations, for although the air is lighter when warm, it is usually at the same time more charged with vapor, whereby the full effect of its lightness upon the barometer is partly or even entirely neutralized; and conversely, although the cold air of the depth of winter is heavier than at other times, driving the mercury upwards, as it is at the same time drier, in consequence of the precipitation of most of its vapor, the barometer does not ascend as high as if the air contained the same weight of vapor that it does in summer. The barometer does not, therefore, rise as high in winter as it would do in a condition of mean atmospheric humidity; nor does it fall so low in summer, and consequently its height is greatly influenced by varying degrees of humidity, both in its diurnal and annual variations, which thus become, when studied in the means of a series of barometrical observations, an index of the grade of atmospheric humidity.

In the next place, as the barometer would necessarily remain stationary were it continually pressed upon by the same mass of air, the frequent changes of atmospheric density which are caused by the intermixture of cold and warm, and of dry and humid currents, in consequence of which clouds already formed are redissolved so that the air becomes heavier, or watery vapor precipitated in the form of hail, snow and rain, whereby the air becomes lighter although colder, occasion constant upward and downward movements of the mercury, often of very remarkable extent.

As all such atmospheric phenomena are either directly caused by wind, or themselves produce wind, the irregular oscillations of the barometer are directly indicative of the windiness of the days or seasons, and the extent of these oscillations or the *range* of the barometer becomes approximately a fair index of the comparative windiness of the months or seasons, as we have seen the variations between the minimum thermometer and the dew point temperature to be. Subjoined is a table showing the sum of these nightly variations of the dew point from the minimum temperature, progressively through August, September and October for four years, from the Charleston records:

	1856	1855	1854	1853
August	76	70	97	94
September	110	87	108	115
October	136	154	119	214

As indicating the windiness of the nights, we observe that these figures regularly increase from August to October, with very distinct similarity in each of the years cited in illustration. Using now, instead of the thermometrical method, that already spoken of, based upon an estimate of the barometrical ranges of the months, we perceive that the table just given agrees in its indications with the one now presented below, which shows the mean monthly barometrical ranges for the year, in Charleston, as computed by myself from a series of thirteen successive years, viz., 1845 to 1857, inclusively.

	Jan.	Feb.	M'ch	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Inches	0.866	0.881	0.763	0.697	0.544	0.417	0.386	0.378	0.510	0.644	0.582	0.837

From both of these tables, we see that the months become steadily windier towards the close of summer, and from the latter table, as already shown by the direct anemometrical records, that August is the least windy month, February being the most so.

In consequence of the dependence of the temperature of the earth's surface, and of the air which is heated by it upon the openness of the sky, and the fact that this elevation of temperature naturally induces an exaltation of the humidity by quickening the processes of evaporation, so rendering the atmosphere comparatively heavier, and producing a disposition towards ascent of the barometrical column of mercury, we find that in the warmer and more humid months, the barometer varies directly with close approximations, as the fairness of the weather; and it is at this time, and for these reasons, that an ascent of the barometer in summer is regarded as indicative of fair weather. Such being the case, as fairness of the day as well as the humidity of the air, are controlling agencies in the production of yellow fever, we should now expect to find that the summer variations in the barometrical heights, likewise exhibit a similar relation to that disease. I present, accordingly,

Table *a*, showing the increments of the barometrical heights for the month of August, from the Charleston records, and for all the obtainable years, or years so recorded, viz., twenty-four:

Years.	Bar. Hts	Hygienic Annotation.	Years.	Bar. Hts	Hygienic Annotation.
1866	30.345	Yellow Fever.	1856	30.084	....
1869	30.2 9	....	1851	30.074	....
1865	30.213	....	1876	30.065	....
1857	30.205	....	1875	30.048	....
1855	30.201	....	1874	30.038	....
1868	30.183	....	1878	30.010	....
1845	30.180	....	1877	30.007	....
1867	30.168	....	1846	29.750	....
1854	30.168	....	1849	29.745	....
1858	30.156	....	1848	29.700	Healthy.
1853	30.112	....	1850	29.695	Healthy.
1852	30.111	....	1847	29.650	Healthy.

The maximum indicates a *sporadic* year, and the three minima healthy years. Subjoined is the companion table of the means:

Table *b*, showing the progression of the nosologieal means for table *a*:

Four Greatest Epidemic Years.	Five Least Epidemic and Sporadic.	Fifteen Healthy Years.
Mean 30.130	Mean 30.080	Mean 30.014

The progression is regular, confirming the indications of the preceding table, and thus establishing the necessary relation of the barometrical heights to yellow fever, as indicative of the primary causative power of fairness of the days and humidity of the air over the production of that disease. I also present a similar table for the month of October:

Table *c*, showing the increments of the barometrical heights for the month of October, from the Charleston reeords, and for all the obtainable years so reeorded, viz., twenty-four:

Years	Bar. Hts.	Hygienic Annotation	Years	Bar. Hts.	Hygienic Annotation.
1858	30.272	Yellow Fever.	1853	30.092	....
1856	30.193	Yellow Fever.	1875	30.089	....
1854	30.171	Yellow Fever.	1877	30.075	....
1866	30.170	Yellow Fever.	1865	30.063	....
1867	30.160	....	1876	39 052	....
1868	30.159	....	1851	30.022	....
1857	30.145	....	1869	29.592	....
1852	30.127	....	1847	29.790	....
1345	30.125	....	1849	29.750	....
1874	30.122	....	1850	29.730	Healthy.
1878	30.120	....	1846	29 545	Healthy.
1855	30.093	....	1848	29.535	Healthy.

The maxima indicate pestilential seasons, and the minima healthy seasons. The three maxima are the years of the three of the greatest epidemics Charleston has ever seen, and the absolute maximum, the heaviest of all her epidemics. Subjoined is the table of the means:

Table *d*, showing the progression of the means in table *c*:

Four Greatest Epidemic Years.	Five Least Epidemic and Sporadic	Fifteen Healthy Years.
Mean 30.191	Mean .... 30.05[illegible]	Mean 29.946

The progression is regular, and corroborates the indications of the preceding table. From the records of the month of October alone, and far more markedly than for August, showing that fairness of the days combined with humidity are very active causes in inducing and maintaining yellow fever in the month of October, we therefore find, that *the barometrical heights are a primary agent* in the production of yellow fever in Charleston, inasmuch *as they indicate the fairness and humidity of the months.* I also present a table showing the movement of the means for September alone, as follows:

Four Greatest Epidemic Years.	Five Least Epidemic and Sporadic.	Fifteen Healthy Years.
Mean. 30.075	Mean 29 999	Mean 29.996

The progression is regular though not very marked. I finally present the means for the entire yellow fever season :

Table *e*, showing the increments of the barometrical heights for August, September and October, conjointly, and for all the years so recorded and obtainable, viz., twenty-four :

Years	Bar. Hts.	Hygienic Annotation.	Years	Bar. Hts.	Hygienic Annotation.
1866	30.216	Yellow Fever.	1852	30.077	....
1868	30.206	....	1878	30.076	....
1855	30.189	....	1874	30 073	....
1865	30.175	....	1875	30.067	....
1858	30.170	....	1876	30.033	....
1867	30.165	....	1877	30.030	....
1857	30.160	....	1869	29.993	....
1856	30.142	....	1849	29.713	....
1854	30.141	....	1847	29.688	Healthy.
1845	30.125	....	1848	29 668	Healthy.
1853	30.124	....	1846	29.662	Healthy.
1851	30 087	....	1850	29.387	Healthy.

The maximum indicates a yellow fever year, though of mild intensity; the four minima indicate healthy seasons. Below is presented the companion table of the mean :

Table *f*, showing the progression of the means for table *e*.

Four Greatest Epidemic Years.	Five Least Epidemic and Sporadic.	Fifteen Healthy Years.
Mean .... 30.13[illegible]	Mean 30.039	Mean 29.976

The progression is regularly incremental, and confirms the indications of the preceding table. The barometrical heights, therefore, taken conjointly for the three months, constitute an expression of the fairness and humidity, and declare these conditions to be *primary agents in the production of yellow fever*, at whose maxima the disease in some mode of intensity *must* occur, at whose minima *it cannot occur*, either primarily *or by contagion*, and whose means of the groups of years, move in parallelism with the intensity of yellow fever, as indicated by the denomination of such groups.

Such are the probative indications of the barometer with reference to yellow fever in Charleston. It must be recollected that all the figures since 1874, inclusively, have been drawn from the Signal Service records; those prior to that year from the municipal records. Nine years of the series from 1845, when the barometrical indications were first recorded in Charleston, cannot now be procured except by recalculation directly from the record books of Charleston. I have done my best to obtain the deficient data, but unavailingly; little doubting that by the increased number of figures, still more pronounced indications of the maxima and minima would be observable in the tables. It must be recollected that the figures of the barometer for August and September, are greatly affected by the prevalence of thunderstorms during those months, whose effect is to confuse the indications of the instrument dependent upon the fairness and humidity, by the cooling influences they exert upon the soil and air. In October, however, when thunderstorms scarcely prevail, this element of disturbance being eliminated, the march of the barometrical increments and the progression of their means, becomes beautifully clear, as shown in the table for October alone.

Having now glanced at the laws of barometrical movement with relation to the subjects under consideration, I present a table of the monthly barometrical heights, with monthly and seasonal means for each of the five years and eleven cities:

ST. LOUIS.						LOUISVILLE.					
Year.	July.	Aug.	Sept.	Oct.	Mean	Year.	July.	Aug.	Sept.	Oct.	Mean
1878	29.935	29 918	30.068	30.038	29.990	1878	29.91	29.891	30.077	30.064	29.986
1877	29.959	29.961	30.004	30.000	29.981	1877	29.945	29.937	29.999	30.00	29.970
1876	29.970	29.99	29.996	30.000	29.992	1876	29.981	30.011	29.968	30.010	29.992
1875	29 96	29.98	30.06	30.041	30.012	1875	29.964	29.968	30.044	30.042	30.004
1874	29.94	29.969	30.029	30.127	30.026	1874	29.965	29.947	30.026	30.110	30.012
Mean	29.9 3	29.960	30.031	30.041	30.000	Mean	29.953	29.951	30.02	30.04	29.993

CAIRO.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	29.967	29.90[illegible]	30.025	30.043	29.985
1877	29.995	29.993	30.033	30.039	30.015
1876	30.005	30.022	30.010	30.041	30.019
1875	29.996	29.999	30.074	30.086	30.039
1874	30.002	29.974	30.048	30.149	30.043
Mean	29.993	29.979	30.038	30.072	30.020

MEMPHIS.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	29.96[illegible]	29.945	30.076	30.090	30.019
1877	30.001	29.997	30.021	30.043	30.015
1876	30.018	30.0[illegible]4	30.024	30.059	30.031
1875	30.024	30.013	30.077	30.108	30.055
1874	30.023	29.989	30.045	30.158	30.054
Mean	30.006	29.994	30.049	30.092	30.035

VICKSBURG.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	29.991	29.987	30.059	30.122	30.040
1877	30.025	30.011	30.007	30.054	30.024
1876	30.045	30.038	30.049	30.083	30.054
1875	30.119	30.070	30.100	30.195	30.121
1874	30.078	30.054	30.080	30.191	30.101
Mean	30.052	30.05[illegible]	30.059	30.129	30.068

GALVESTON.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	29.957	29.945	29.960	30.063	29.981
1877	30.006	29.985	29.942	29.990	29.981
1876	30.035	30.006	30.032	30.048	30.030
1875	30.052	29.998	29.984	30.104	30.034
1874	30.022	29.99[illegible]	29.973	30.119	30.027
Mean	30.014	29.985	29.978	30.065	30.011

NEW ORLEANS.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	29.962	29.955	30.026	30.075	30.0[illegible]4
1877	30.006	29.981	29.945	30.011	29.984
1876	30.037	30.021	30.009	30.048	30.029
1875	30.090	30.025	30.017	30.115	30.062
1874	30.039	30.006	30.006	30.115	30.04[illegible]
Mean	30.026	29.997	30.001	30.073	30.[illegible]24

MOBILE.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	29.984	29.979	30.051	30.105	30.03[illegible]
1877	30.009	29.994	29.966	30.036	30.[illegible]1
1876	30.053	30.041	30.00[illegible]	30.058	30.039
1875	30.104	30.03[illegible]	30.036	30.121	30.074
1874	30.054	30.017	30.025	30.128	30.056
Mean	30.041	30.015	30.017	30.090	30.040

CHARLESTON.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	30.046	30.003	30.101	30.120	30.067
1877	30.033	30.007	30.009	30.075	30.031
1876	30.068	30.065	29.982	30.052	30.[illegible]42
1875	30.087	30.04	30.064	30.089	30.[illegible]72
1874	30.058	30.038	30.058	30.122	3[illegible].069
Mean	30.058	30.030	30.041	30.092	30.057

NORFOLK.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	29.99[illegible]	29.951	30.122	30.098	30.041
1877	29.985	29.980	30.059	30.072	30.024
1876	30.036	30.061	29.973	30.045	30.029
1875	30.021	30.028	30.064	30.046	30.040
1874	30.071	30.038	30.094	30.145	30.087
Mean	30.022	30.012	30.062	30.081	30.044

PHILADELPHIA.

Year.	July.	Aug.	Sept.	Oct.	Mean
1878	29.959	29.946	30.143	30.066	30.028
1877	29.953	29.954	30.077	30.062	30.011
1876	29.993	30.061	29.984	30.020	30.014
1875	29.996	30.035	30.035	30.015	30.020
1874	30.030	30.032	30.100	30.115	30.069
Mean	29.986	30.00[illegible]	30.06[illegible]	30.07[illegible]	30.028

The figures given above have all been corrected when the observations were recorded in the offices of the Signal Service, for temperature, altitude above the sea level, and instrumental error, and are consequently strictly comparable with each other.

We observe in the first place, a steady diminution of the seasonal means from the year 1875 to 1878, indicative of the gradual increase of seasonal temperature already pointed out, which culminated in the great heat of 1878, except in Philadelphia, where 1878 was not the hottest year of the five. In Charleston likewise, where 1878 was not a very hot year, we observe some traces of such a progression, but the temperature of 1878 was very nearly that of 1875.

In every city except Charleston and Philadelphia, the atmospheric pressure of 1878 was below its quinquennial mean. In Philadelphia the figures are the same, and at Charleston the pressure for 1878 was .010 greater than its five-yearly mean.

The great heat of July in St. Louis, is indicated by the figures 29.935, and in Louisville by a pressure of 29.912, the two lowest to be found in the whole series, for any months or cities. I have shown that October is properly the month in which the indications of the barometer with respect to fairness of the days and atmospheric humidity, are least liable to interference from the prevalence of thunderstorms, which rarely occur in that month. Let us, therefore, examine September and especially October in connection with the prevalence of yellow fever in 1878.

Yellow fever prevailed in a very limited way in St. Louis in October, the great majority of cases occurring in that month. We accordingly find that the pressure, as indicative of fairness and humidity, was greater than that of any October for the three years previous, and very near its mean, while the month of September, in which the first cases occurred, was actually higher than its mean and *higher* than any figure for the same month in the *series of five years.*

In Louisville, also, the pressure of September was the greatest of five years, that of October being above its mean, and greater than any other of the same designation except 1874.

In Cairo, we note a pressure which, in spite of the depressing influence of temperature on the barometer, is still higher than any recorded since 1875.

In Memphis the pressure for September was considerably above its mean, and within *one thousandth* as high as had been

attained *during the five years*. In October it was just about its mean.

In Vicksburg the pressure was exactly at its mean, and in October .007 below it.

In New Orleans the pressures for September and October were unusually high, that for September being *the highest of five years*, and for October the highest since 1875.

In Mobile the pressure for September was higher than it had *been for five years*, and in October not so unusually high, but still higher than its mean or any figure since 1875.

As in almost every other instance, in spite of these high pressures of the later months, the low pressures due to uncommon heat in July and August sufficed to reduce the seasonal mean for 1878 below that of the average of the five years.

Having now observed that the pressures in September and October, in the cities where yellow fever prevailed, were unusually high, and in several instances unprecedented as far as these records go, let us examine the cities in which the disease did not prevail.

In Galveston the pressure for September was considerably *below* its mean, indicating unfairness of the weather, and so also in October. In Charleston, the pressure for September was considerably higher than its mean, in consequence of the moderate temperature, which was slightly above the normal. In October, the pressure was also somewhat (.028) above its mean, the temperature being still above the normal, but lower than in 1875, as is indicated also by the *lower* pressure of this latter year.

In Norfolk the pressures, both in September and October, were above their means, and in Philadelphia likewise, but still more distinctly. This is explained by the very moderate temperature of these cities in 1878, as compared with the cities of the Gulf Coast and Mississippi Valley.

ANTAGONISM OF YELLOW FEVER TO PNEUMONIA, CATARRHAL AFFECTIONS AND CONSUMPTION.

As already observed, I published in 1868, in the *Southern Journal of the Medical Sciences* (of New Orleans), an article originally forming a part of the investigations bearing upon the etiology of yellow fever, from which I have extracted briefly, in the substance of this report, showing that a direct antagonism exists

between yellow fever and pneumonia, between yellow fever and catarrhal diseases generally, and between yellow fever and deaths by consumption. The maxima of deaths by yellow fever coincide with the minima by pneumonia, and conversely, and the means of the yellow fever intensities progress *inversely* as the number of deaths by pneumonia in August, September and October, conjointly.

As deaths by catarrhal diseases, such as catarrhal fever, dengue, anginose affections, etc , are not very frequent, although a similar relation between the group and yellow fever was also shown, I quoted the records of the Medical Society, of South Carolina, for nearly one hundred years prior to 1857, to show that in all well-marked epidemics of influenza, yellow fever was either wholly absent, or recorded for a very few cases only, and that when yellow fever prevailed in an epidemic form, catarrh was absent. I also showed that during the prevalence of yellow fever, deaths by consumption very rarely occurred, being postponed by the presence of the epidemic until November, when a greater mortality occurred *in that month* than in years when yellow fever did not prevail. I also showed, that in catarrhal seasons, deaths by consumption were most frequent, occurring through the summer months in unusual frequency. These antagonisms can only be explained, as I took occasion to do in the article referred to, upon a supposition of the higher windiness and ozonicity of the seasons when pneumonia, catarrhal diseases generally, and deaths by consumption are more frequent. An undue ozonicity of the air is indisputably the exciting cause of influenza and catarrhal fever, and of dengue likewise, provided it appears irregularly, in conjunction with uncommon heat. The effect of an undue ozonicity upon consumption is to greatly aggravate the disease, while its deficiency and absence, as during epidemics of yellow fever, and perhaps also the heat and moisture proper to the air at such times, mitigate the symptoms and defers the almost inevitable mortality until the winds begin to blow again and the ozonicity to rise in October and November. Many of the deaths by pneumonia noted in Charleston for the months of the yellow fever season are doubtless due to aggravation of catarrh, as a complication of influenza. In the winter and early spring, when the ozonicity is naturally highest, deaths by pneumonia are most frequent, and a form of pulmonary congestion of exceedingly rapid progress and most fatal type, killing often after a few

hours, before inflammation of the lungs or pleuræ have had time to become established, was frequent, prior to 1860, among the blacks on the plantations in the vicinity of Charleston and Savannah, where it was termed "typhoid" pneumonia.

Assuming, therefore, as is now generally admitted, that ozone is the exciting cause of pneumonia, catarrh and anginose affections, upon the basis of various predisposing conditions, (as a matter of course,) and an aggravating condition in the progress of consumption—inasmuch as the diseases named are strictly antagonistic, by their maxima and minima, to yellow fever—we find in these facts an illustration and corroboration of the antagonism demonstrated between the prevalence of thunderstorms and yellow fever, since thunderstorms naturally induce and maintain an uncommon freedom of the air from local humidity and miasmatic effluvia, and are accompanied with an increase of the ozonicity of the atmosphere.

THE ARGUMENT AND CONCLUDING REMARKS.

It has now been demonstrated, by a mode of proof whose cogency is absolute, that heat, unusual fairness of the days, high humidity of the air and calmness of the nights are indispensable agents in the production of yellow fever in Charleston. And conversely, that windiness of the season, an uncommon prevalence of thunderstorms, the prevalence of ocean winds and a high degree of atmospheric ozonicity are primary agents in the *prevention*, moderation and arrest of yellow fever.

When I first undertook these investigations into the relations of the meteorology of Charleston to yellow fever, I had but little hope of reaching any positive conclusions by so doing, and was constantly told that repeated efforts of the sort had always resulted in failure. I determined, however, to study as long a series of years as possible, and found that reliable figures could be obtained as far back as 1832, a date at which municipal registrations were practiced in scarcely any other city of the United States. With these and the corresponding necrology at hand, in a very lengthy and laborious series of computations made in 1854–55, I endeavored to group the meteorological data in such a way as to establish the existence of a coeffiient which should express the combined power of heat, humidity, rainfall, and calmness of the weather. I could not, however, discover any such figure; but, in making out the tables, most of which are

still in my possession, I observed how often yellow fever qualified the highest and higher figures of the temperature, fairness of the days, dew point, etc., and how often, at the same time, the minima of the same tables were qualified by the annotation of "health." I was then led to test the indications of these figures by arranging them in an incremental order, and comparing the means of the healthy years with those of the years in which yellow fever had prevailed in its most intense form. Finding that the difference between these means were uniformly in the direction suggested by the extremes, I next tabulated the years into four groups, as shown in one of the earlier tables of this report, and found that, in the great majority of cases, the movement of even the four means was in exact accordance with the indications of the extremes. I was thus led to formulate the method as a mode of investigation, and to apply it also, to agencies which were supposed to be adverse to the existence of yellow fever, in a great variety of ways, almost all, indeed, which the figures were capable of expressing. In many instances the conditions tested were found to possess no direct relation to yellow fever, either positively or negatively; but in others, as in the contrary case of the temperature, fairness of the days and humidity of the air, the establishment of these conditions as indispensable agencies in the prevention of yellow fever, was at once conspicuous. The system, as at length elaborated, was applied to special groups of diseases, under various hypotheses of their relations to each other and to yellow fever, with results which greatly tended to enlighten my conceptions of the causes of this disease, and to substantiate what had already been accomplished.

I was very greatly astonished to find in the progress of these investigations, that order could thus be determined in a mass of data hitherto assumed to be chaotic, and that the laws of the existence and continuance of yellow fever could thus be determined by a mode of proof which possesses all the force of a mathematical demonstration. That the influences in this way found to be primary agents, are really so, can never be doubted for a moment. At the same time, the system of investigation may be pushed with increasing accuracy of purpose, and with greater definiteness as regards the secondary conditions, positive or negative, of yellow fever, the more various the meteorological records, and the longer the series of years at our command.

The *argument* of these researches is as follows: we find that certain conditions, such as the temperature, the fairness of the days, the prevalence of thunderstorms, etc, are primary agents either in the prevention or production of yellow fever; but *these very agencies are also primary agencies in the promotion or prevention of putrefaction*, whence, consequently, the only legitimate conclusion must be, that yellow fever is associated with putrefaction, and that the animal body is injuriously affected by causes which promote putrefaction.

The final and incontrovertible evidence of this relationship is afforded in the facts that the calmness of the nights, as shown by the table of dew point variations, is a primary agent in the *production* of yellow fever, and that thunderstorms are a primary agency, like the sea winds, in the *prevention* of yellow fever. For no possible relationship can exist, between yellow fever and these agencies, in the face of an association between yellow fever and putrefaction *already determined*, except upon the rational assumption, that calmness of the days and especially of the nights, increases the temperature of the soil and of the human body, and favors the accumulation of noxious effluvia in the air and their consequent inhalation or application in some way to the human body, and that winds and thunderstorms by atmospheric commotion and high accompanying ozonicity, accomplish the dispersion and destruction of these results of putrefaction. Thus, yellow fever is proved to be directly due to the conditions, promoted or removed, of which the most prominent is the effluvia of putrefaction so allowed to accumulate, or blown away by winds and destroyed by oxidation. These special records, in their establishment as primary agents in the causation of yellow fever, *rivet* the chain of evidence, and completely establish the assumption that yellow fever is primarily caused by the effluvia of putrefaction absorbed by the human body under conditions of systemic excitement and functional disturbance, due to high or long continued heat and humidity.

It has always been my desire to investigate the meteorological records of New York, Philadelphia, Havana, Mobile, New Orleans and Natchez, according to the method pursued for Charleston. Only the thermometrical records can be generally obtained in smaller cities. The records of Charleston are the most complete by far of any city in the United States, except perhaps, Philadelphia or Boston. Charleston has reason to be

proud of her meteorological devotion, having contributed through the model monogragh on "Dew" by Wells, some classical matter to the "Science of the Atmosphere"—which has in general been much neglected even in the greater cities of the South. All records of cities where yellow fever prevailed occasionally or frequently, should be thorougly systematized according to the method I have supplied to the Charleston records; that by *parallelism* will show nothing at all of a satisfactory nature. Although so anxious to make these comparative researches, it has been entirely out of my power to do so; indeed, a labor of this kind is beyond the scope of a single individual engaged in the constant routine of professional life, since a prolonged visit *in person* to each city, and much assistance from the local authorities and from private citizens, is necessary to obtain truthful data for a sufficiently long period of years. In most places, records of an official character, have not been made prior to the war of 1861. Even in New Orleans, nothing approaching in completeness to the figures of Charleston can be obtained, except perhaps, from private records, in which some of the most important notations, are either deficient altogether, or so made as not to be comparable with those of later years.

I am now perfectly sure that the principal cause of the apparent irrelevancy of the meteorological figures to yellow fever, so long maintained by those who attempted to investigate these matters by the simple method of parallelism, has been due to the *contagiousness* of the disease, obscured in the South, by the number of really autochthonous cases, but constantly active nevertheless, in effecting a propagation of the disease when once appearing, at times exceedingly rapid, in the presence of no very exalted temperature or humidity, etc., and at other times scarcely perceptible, notwithstanding the concurrence of *some* of the favoring conditions of the disease. Inasmuch as yellow fever is thus caused in two ways, 1st, by the effluvia of putrefaction, and 2d, by contagious effluvia from the sick, it is evident that the number of cases in a city cannot be expected always to vary directly as the intensity of the causes producing putrefaction, for this is but one of the factors in the multiplication of cases. It is therefore very astonishing to find that yellow fever really acknowledges the power of these agencies, and I have no hesitation in affirming, that were the element of contagiousness removed from a consideration of the origin of yellow fever, we would find its

etiology so simple that the number of cases reported at any given point would vary as distinctly with the heat, humidity, calmness of the nights, and quantity of putrescible matter present, as we find sunstroke to do, with the heat and humidity. The problem of the orgin of yellow fever would have been solved long ago.

As it is, the contagiousness of the disease constantly steps in as an independent factor in the generation of new cases, where-ever approximately similar meteorological and terrene conditions exist, and by implanting yellow fever prematurely in distant cities and towns, leads to the impression that these particular places would have certainly escaped, had it not been so implanted, and that wherever occurring, yellow fever is due to a contagious principle brought from some other place where the disease exists or had done so at a previous period. By the acceptance of this specious doctrine and of the numerous chimerical hypotheses shaken together to give it a semblance of support, an immense amount of trouble is apparently saved. By adopting it, all the close physical study necessary for a proper understanding of the meteorology and miasmology of the subject, all the difficulties of pathological study and all the expense and watchfulness of efficient sanitation, a great mass of labor which has nearly overborne those who distrusted the simplicity of the creed proposed, is dispensed with as altogether superfluous.

Such a doctrine is far more acceptable than one which compels us to strenuous mental and bodily effort, and literally to work out our sanitary salvation. It is very greatly easier to declare a Quarantine, and to fumigate a vessel two or three times a week, than to pave cities, dig drains, supply water and abolish sources of putrescence. It is far more flattering to the self-love of citizens to accuse a foreign port of infection than to admit that in their own city, a thousand sources of disease exist. It is infinitely cheaper, at first, though far costlier in the end, to practice the simple routine of a Quarantine station, than to undertake the huge work of cleansing a filthy city, of remodelling her streets and dwellings, and of supplying her abundantly with pure water. Quarantine is simple and cheap, sanitation exceedingly complex, and its duties arduous and continual. Nevertheless, without neglecting an efficient quarantine, these duties must be fulfilled in every city liable to yellow fever, if any desire exist to escape the visitations of this scourge. Sooner or later it may come, wherever *the common surroundings of domestic life* exist, in

a city built upon a flat expanse, devoid of natural drainage, in a hot climate and at the sea level.

Sooner or later, the heat will be more intense than usual, the the humidity greater, the winds cease to blow and thunder to be heard, and a few cases occurring in the filthiest spots, will kindle a contagion that may slay thousands, and alarm a continent.

The day has come when we must forever cast aside this jejune doctrine of exclusive importation; knowing its fallaciousness, we must henceforth refuse to be seduced into apathy by its treacherous seductiveness; knowing its falseness, we must peremptorily refuse to be led by the men whose lack of insight has allowed communities entrusted to their care, to slumber in the very jaws of death.

It is constantly affirmed that the Southern cities are not in a bad sanitary condition, and that many parts of the finest cities north of latitude 38°, are in quite as bad a condition as any of them. This is altogether a misstatement, and if true, would signify very little indeed. For the last twenty-five years, I have keenly watched these points, in a quiet way, in the principal Southern cities. Their hygienic difficulties, owing to a location in almost every case, on low flat plains near the ocean or rivers, or on the Gulf of Mexico, are almost insuperable. No natural cleansing, like that which occurs for cities built on elevated undulating ground is possible—all must be artificial. But at the same time, cow-yards and stables are universally permitted, and above all, the execrable system of privies without drainage, built in the ground, is practiced in every one of them. Is this so in New York, Boston, St. Louis, or even in the Philadelphia of our day, except in the most unusual cases? In New Orleans the privies are built partially *above ground, mirabile, dictu*, in accordance with the requirements of *the Board of Health!* I quote from sec. 8, of "Ordinances of the Board of Health of the State of Louisiana, May 18th, 1870," as published in the annual report of the Board of Health for the year 1872: "Any privy hereafter constructed, shall be not to exceed two feet below the surface of the ground, and be walled with brick or stone, laid in cement its whole depth, with water tight bottom, and said wall shall be raised at least one foot above the surface of the ground, and shall be so constructed, as not to have any issue or opening on any street, way, yard or place, nor shall it be within three feet of any

street or way * * * and shall have a flue or ventilator sufficient for ventilation, extending above the surrounding windows or communicating with a chimney" (p. 158). A third of this shallow vault is purposely built above the surface, and the pit is sunk but two feet into the ground. This is done for the convenience of the vidangeurs, who by law, and under very rigid restriction, clean out these privies in May or June. After such a "cleansing" and "disinfection," the contents of these places become offensive again in a few days, built as they are, in a far worse situation, so far as accession of heat is concerned, than if sunk deep in the muddy soil. The care of such places, moreover, is submitted to the horrible manipulations of vidangeurs, instead to the natural rush of the great river which flows so near. In Charleston the condition is the same, and it is, if possible, still worse in Memphis. In Mobile, Savannah, Norfolk, Galveston, and Vicksburg, the same fatal nuisance is tolerated.

Entirely similar remarks are applicable to the keeping of cows. A cow is an exceedingly filthy animal when kept in a city, and the practice of doing so ought not to be tolerated in any part of the world. But in New Orleans, while the keeping of a hog is forbidden, these filthy creatures are allowed, subject to a supervision of the Board of Health, which cannot possibly reach the conditions. In Charleston, during yellow fever epidemics, and within a few feet of most malignant cases, I have seen rows of cows (1858) standing nearly up to their knees in their own ordure, *panting* in the broiling heat under a bare shed. Such things are not tolerated in our great northern cities, which have long since seen the evil of such practices, and have supplied themselves with fresh and pure water in unlimited amounts, as the very foundation of anything like a proper sanitation. All these considerations become still more cogent when we recollect the great differerences in climate between cities north of 38°, and those of five or six degrees of latitude further south. The difference of latitude is practically equivalent to an extension of the length of summer, for a month or six weeks in either direction, with the steady maintenance of a high *mean* temperature for the whole of the period.

I have only a word or two to say with regard to quarantine restrictions. *The existence of yellow fever in any city in the epidemic form*, to say the least, *is absolute proof of the defective sanitation of such a city.* I do most solemnly advocate, consequently,

the establishment of a rigid quarantine against such a city, in every place whatsoever, in communication with it by land or water during the warm season. I do this, *knowing* that in many of the cities instituting quarantine against such an infected city, yellow fever may and will arise behind the most rigid quarantine that man can devise or practice, by the spontaneous generation of the disease. But in numerous cases lives will be saved, and the outbreak of yellow fever at least delayed, so far as the disease is precipitable by contagion. My chief object in advocating so rigid a system, is to place a city whose sanitation is thus proved to be defective, and which thus becomes a source of untold detriment and alarm to the whole country, through its most culpable neglect of all that science and common sense can teach, under the condemnation and punishment of the region of country in which it is situated. Let its citizens be removed, as was long ago advocated by Grisolle, let the state or general government provide for those who cannot be sent away, so that no suffering be possible; but let the city itself, as long as the epidemic lasts, be absolutely sequestrated from all communication, commercial or social, with the rest of the world. When this is practiced once or twice, sanitation will be attended to, and the demands of neighboring communities who have rights that *must* be respected will be heeded. *Otherwise nothing will be done.* Year by year will pass, and the population after each frightful lesson, will plunge again into the absorbing vortex of business, heedless of what is sure to come again when the sun shines out hotly and the breezes die away; heedless of the infinite alarm and pecuniary loss their negligence is certain to inflict upon innocent communities who have long since expended money beyond their means in the purchase of all that can keep their habitations clean. While my heart goes out in the tenderest sympathy for the unfortunate citizens of our plague-stricken cities, while I have from my youth been familiar with the awful scenes of yellow fever epidemics—not knowing quiet or hardly sleep as long as they lasted—for their own good, as the only way in which the iron necessities of their situation can be brought *home to them*, as the only measure which will certainly compel them to do what sanitary science demands in their case, much more indeed than would be necessary in cities further north, but absolutely imperative amid their naturally disadvantageous surroundings, I am thus compelled to recommend the most rigid enforcement of quarantine restrictions

which can be practiced against their cities and against themselves.

We, however, who live in the cities farther north, must not think that all our tasks are accomplished. Much remains to be done even with us, especially in our flat cities. We are not wholly beyond the grasp of yellow fever, although our summers are too short, and days and nights too windy for the establishment of notable epidemics. At the South, however, this is quite otherwise; but, by the scrupulous and unremitting practice of measures demanded by the laws of hygiene, although cases of yellow fever will now and then occur by contagion from other places, or in a sporadic way, by local generation, in spite of the utmost vigilance, epidemics will cease to appear.

When the filthy, stagnant, stinking Bay of Havana shall have been purified, and its narrow, pathlike and crooked streets widened and opened to the winds; when water shall be supplied in abundance and her privies abolished; when New Orleans shall be paved, and drained into a canal through which the swift current of the Misissippi perpetually flows, and her people be taught that filth which does not meet the eye, can nevertheless travel upon the air on its mission of death; when the flat surfaces of our American cities liable to yellow fever shall have been covered with *stone* and provided with all the lavish water supply they need; when their citizens admit the harsh and most unpalatable truth that pestilence may originate in their homes, and learn that a foul smell in a hot climate is the very breath of the destroying angel, epidemics will become impossible, although some cases of yellow fever will always be seen, for the human heart is hard, and art is long.

THE THEORY AND PRACTICE

OF THE

ADMINISTRATION OF VERATRUM VIRIDE

IN

YELLOW FEVER.

PART V.

As a native of Charleston, and a resident of the South until within a few years past, I was impressed very early in my professional career with the necessity of pushing our studies of the pathology and treatment of yellow fever, and of endeavoring by experiment and clinical observation, as well as by generalizing what knowledge had up to that time been acquired of the nature of fever, to anticipate, if possible, the general march of medical science in these directions. I was of course by no means alone in such convictions or efforts, for every thoughtful practitioner of the South was as eager as I was for improvement in such matters. As a result of the general attention devoted to these subjects, very great advances have been realized within the past twenty-five years in all that pertains to the natural history of this fearful disease, by the labors of the profession in this country especially; though we must by no means fail in a grateful acknowledgment of the primary value of the contributions to the literature of yellow fever placed at our command by the older writers of the United States and Europe. Lining, Gilbert Blane, (1785) C. Chisolm, (1796) Rush (1793), Currie of Philadelphia, (1798) Deveze, (1797) Victor Bally, (1814) Louis and Trousseau, (1828) have contributed the main portion of what is classical, and a lengthy list of writers in all parts of Europe and the United States, have published minor articles, detailing their individual experiences, or contributing information of more or less value on pathological and therapeutical points, since Shuttuck's

translation of Louis appeared (1839). No work on yellow fever has ever contributed so much to an exact knowledge of the symptomatology and pathological anatomy of this disease, as this wonderfully graphic and truthful history of the epidemic at Gibraltar in 1828.

But while we are now able to recognize clearly the essential features of yellow fever both in the living and dead subject, and are closely instructed with regard to the clinical characteristics of the disease, recognizing its contagiousness, the continuity of its febrile movement *in the great majority of cases*, the early disposition toward general congestion, the later proclivity towards visceral stasis, obstruction, and secondary inflammation, the depravation of the blood by the exorbitant overflow of biliary matters formed in the liver, and the inherent and distinguishing disposition of the whole economy towards a septic condition, latent in all cases, but manifested most unmistakably in those which are destined to be fatal, I cannot say that our therapeutical procedures evince any improvement upon those of our ancestors, comparable to that observable in the natural history and pathological anatomy of the affection.

Almost every conceivable method of treatment has been tried, Murcury sometimes pushed to salivation, (Chisolm, and of late, S. H. Dickson); venesection, (Rush, Dewees, Robert Jackson, Chisholm and Dickson); quinine, (Lafuente in Andalusia, early in this century, Blair in Demerara); emetics (Arejula of Andalusia, O'Halloran, Hacket); purgatives (Rush, Dickson, Hacket); diaphoretics with warm drinks, as in the so called Mobile or Creole method; refrigerátion by ice packing, or with cold water in accordance with the principles of Currie, of Liverpool, late in the last century; blistering, frictions with croton oil to the surface generally; sedation by aconite and digitalis; all of these, either as exclusive methods, or in combination with each other, have been advocated in the past, and several of them are still practiced with more or less modification. Nevertheless, the general mortality by yellow fever has been little if at all reduced, from the times of the earlier practitioners to our day. In Murcia in 1804, of the first 134 cases, only three or four recovered. In the early part of the epidemic at Gibraltar in 1828, very few recoveries took place.

Gilkrest states of the treatment in Gibraltar, that a full consideration of the subject must prove that the *expectant* system or

any system of "mild popular remedies," cannot be admitted, (as has been attempted to be shown) to be followed by less mortality than what our French neighbors call *"les moyens perterbateurs."* Under the mild, or what has been called the French and Spanish treatment, which consists in the avoidance of the lancet, warm aromatic drinks, sinapisms to the extremities, primary purgation with calomel and jalap, and calomel in divided doses afterwards, if vomiting is present, with supporting measures still later if necessary, but in general, in the avoidance of mercurials altogether, the mortality at Malaga in 1803, was 11,486, out of a population of 36,054. Sir J. Fellowes, whose practice at Cadiz was as just stated, including the use of mercury, however, as an alterative, states that in 1800, the mortality in that city and its suburbs, was one in six and a-half. In Charleston in 1854 at the Roper Hospital, out of ninety-three cases, of which I have detailed notes taken by myself at the time in the service of Dr. W. T. Wragg, the mortality was 33, or over 35 per cent. In Wragg's Roper Hospital report, the mortality among 254 cases treated, is stated as ninety-two, or 36 per cent. In the same institution in 1858, the mortality was about 50 per cent. In that year, the average mortality of the patients attended by the Howard Association in Charleston, was nearly 30 per cent. In New Orleans in 1878, the mortality was 4,600 out of 27,000 cases, about one in six. In Memphis in 1878, 5,000 deaths occurred out of 18,500 cases, a mortality of more than 33 per cent. In Vicksburg in 1878, there was 1,121 deaths out of 5,000 cases, a percentage of 22 per cent. In Granada, Miss., in 1878, the mortality was about one in three cases. In Louisville in 1878, the mortality was twenty-eight out of fifty local cases. In the yellow fever hospital at Louisville, the mortality was 44 per cent. In Cairo, no less than fifty-one deaths occurred out of eighty-eight cases; and in St. Louis, seventy-one deaths out of 151 cases, or a ratio of 47 per cent.

In the earlier periods of the epidemic, the mortality was invariably far higher than at a later period, both at the South and on the Upper Mississippi, in conformity with a well known feature of yellow fever. Taking the mean of these figures, we may estimate the general mortality of yellow fever throughout the season of 1878, at *over one in three for all cases*; which is just about the average of the mild Spanish or expectant treatment. It cannot be said, therefore, that our treatment has become more

effective since Fellowes practiced at Cadiz in 1800, or Flores in 1813.

In private practice, very different results from this are occasionally claimed. In 1858, in Charleston, Dr. T. L. Ogier reports a series of 86 cases, with but 2 deaths, the treatment being mostly expectant, with the exception of irritation of the skin with croton oil, and the internal use of aconite. It must be said, however, of these cases, that 54 were children and negroes, among whom the mortality is naturally small. Rollet, of Havana, in a late publication, describes the method of treatment he adopts as consisting in the use of local blood-letting by cuppings in preference to leeching, if there is much headache, on the nape of the neck, loins and stomach, with ipecac as an emetic if the disease has been ushered in with vomiting, and aconite freely given afterwards, the bowels having been cleared by castor oil or sulphate of magnesia. Rollet practices the administration of calomel, both as a purgative, early in the case, and as an alterative, later, and sulphate of quinine after the fever has declined. He claims that, of 100 cases seen in the commencement of the disease, not more than 5 will be lost, from 20 to 30 seen in the second stage, and less than three-fourths in the third stage, by the treatment he adopts. On the other hand, practitioners in Charleston and New Orleans esteem themselves fortunate if they lose no more than 15 per cent of their cases. In the practice of Dr. Samuel Logan and Wm. Martin, Acting Assistant Surgeon of the United States Navy, at the Pensacola Navy Yard, in the fall of 1874, in cases treated exclusively by these gentlemen, the mortality was 1 death in every 4.6 cases, which Dr. Logan does not seem to think excessive. The treatment was by a mild emetic given only in appropriate cases, followed by a mercurial or saline purgative, or by castor oil. The patient was encouraged to drink warm teas, but not to do so to excess. He was also allowed ice in moderation if he desired it. As soon as the bowels were emptied, nutrition was carefully begun and systematically conducted, rice gruel, and, later, beef tea and chicken tea being used for this purpose. Stimulants were used in the course of the disease, when indicated, with great care to employ them only as needed. Complications were met as they manifested themselves. Mercury was not given systematically during the progress of the disease. The treatment applied is thus seen to have been a good type of what is called "expectant,"

with a leaning to the diaphoretic "Mobile" or "Creole" plan. The cases, however, were of unusual malignity, and all or nearly so in *unacclimated* persons, and the results attained highly satisfactory under the mode of treatment employed.

No special mode of treatment is applicable to every case of yellow fever, for, like every other disease, yellow fever presents itself to the practitioner under many different aspects. The chief conditions which affect the typical progress of the malady, and consequently modify the primary indications of treatment, are: 1st, partial or total acclimation; 2d, age; 3d, the condition of pregnancy; 4th, the presence of malarial intoxication to a greater or less extent; 5th, the season of the year; 6th, the stage of the disease; and, 7th, the type of the disease. Each of these conditions I will discuss succinctly further on, but at present I must say a few words, in accordance with the plan of this contribution, and by way of explanation of what is to follow, with regard to the essential nature of fever generally, and of yellow fever in particular, from a pathological standpoint. I shall then expose what I regard as the most rational and effective treatment of a typical case of yellow fever seen early, and afterwards note the variations from the fundamental line of treatment which become necessary in each of the conditions above enumerated.

Heat is at once the prime condition and result of life. Below a certain grade of temperature, which varies in different animals, no play of vitality is exhibited, while in all living creatures the activity of the processes of life is heightened by superior grades of temperature, and the activity of all the organs quickened in direct ratio to the rise of temperature, until limits are reached which likewise vary with the class. No living creature, as far as we have occasion to know, is absolutely dependent, for its somatic temperature, upon the medium in which it lives. In animals, and especially in the terrestrial mammalia and birds, this function of calorefaction due to the organic processes of the individual, is especially marked. The temperature of these creatures, including man, is normally much higher than that of the air, and is maintained, by reactive mechanisms, at a grade which does not vary greatly from a physiological mean, during the normal condition, although liable to comparatively wide fluctuations in a pathological state. It is with the disastrous effects of these fluctuations, when carried to their extremes, that therapeutic

art has to deal. Ever since the promulgation of Graham's fundamental conditions of matter as *colloidal* and *crystalloidal*, and consequent inferences as to the production of heat and force by the passage of the former into the latter forms, in conjunction with Herbert Spencer's still more comprehensive and distinct enunciations of the same idea, physiology has strongly tended to relinquish the older doctrines of the dependence of animal heat and power upon oxidation. Even Liebig himself, the founder of these views, abnegated them a few years since, not long before his death. We now recognize the transformation of the solids of the tissues, and of the different elements of colloidal nature proper to the lymph and blood, into matters of crystalloidal nature whose molecules are grouped more closely than in the matters out of which they are formed, as the source of all the powers manifested by animals. And it must be held, still further, that changes of this character belong essentially to the group of molecular movements known as fermentations, which modern physiology has shown to be so characteristic of the functional play of both animal and vegetable life. Fermentative movements, therefore, in almost endless variety, and of the most comprehensive character, are the basis of animal heat and of the polar excitements everywhere active in the economy, but especially manifested in the nervous and muscular systems, and it is essentially in virtue of this fermentative character of all its common nutritive movements, that the animal economy is so prone to perturbation, by the absorption of septic (fermentative) matters from without, which act the part of ferments, when by absorption they become diffused through the blood and other fluids.

While, therefore, a liberation of heat is the direct consequence of vital activity, it is no less true, that all polar manifestations are maintained by heat, and vary within certain limits directly with the temperature, and the same is equally true for all chemical action, which indeed essentially belongs to the category of phenomena having various modifications and reactions of the polarity of molecules as its basis. In the normal state, consequently both the chemical movements of the body, and all of its manifestations, such as the play of muscular and nervous power, sensation, and the other intellectual powers, vary with the temperature, being sustained by it, mounting and declining with it. What is true for health, is no less so, for the conditions of

natural action which we term pathological, so that, as is now universally admitted, though little more than sketched in a general way, twenty years ago, the phenomena of morbid change and of morbid excitability, both of the organs of animal and vegetative life and of the nervous system likewise, are directly enhanced by a rise in temperature of the body, and as strictly reduced to a lower grade by a reduction of it. This proposition is the basis of the use of cooling application in fever, a practice which is coeval in antiquity with medical art, but in modern times more distinctly advocated by Wright, Currie of Liverpool, DeHahn of Breslau, and Gregory, towards the close of the last century.

The advantages of a reduction of temperature in most cases, and essentially in those where the fever runs into a so called "hyperpyrectic" grade, as in certain cases of rheumatic, typhoid, exanthematous and yellow fever, are at the present day recognized by every properly trained practitioner. It is now thoroughly well known, that a reduction of temperature under such circumstances is accompanied with a progressive diminution of general excitability and anxiety, of the pains so frequent in fever, of the reflex excitability of the nervous system and of special organs, of the rate of the respiration, and of the rapidity of the heart's beating. But the converse of this proposition, now so familiar to the profession, and indeed long ago very well understood, viz., that a reduction of the force, volume and frequency of the heart's action, effects a progressive reduction of all the general and local expressions of fever, and a simultaneous declension of the temperature, which is *the text of the present short dissertation, and the object of the use of veratrum viride* and of all agents which directly reduce the frequency of the action of the heart, is by no means so well understood, and twenty years ago was not acted upon with any definite purpose of abating the nutritive excitment of fever in general, or of limiting the activity of the organic viscera.

The proposition with regard to the influence of temperature upon the nutritve functious being axiomatic, it necessarily follows that whatever affects the heat of the body must influenee all the phenomena dependent upon heat. Inasmuch as temperature is the coefficient of nutritive activity, and as the activity of nutrition is administered to by the circulation of the blood, and directly proportionate in activity to the velocity and quantity of the circulating fluid sent to all parts of the economy, what-

ever affects the circulation must likewise influence the prevailing grade of temperature, both generally and locally, positively and negatively.

In the normal state muscular action, running, and unusual mental activity, cause an increase of the velocity and strength of the heart's action, and a rise in general temperature. So also do many substances, such as condiments or stimulants, taken into the alimentary canal or applied to the surface of the body.

In morbid conditions, such substances as capsicum, pepper, Dippel's oil, ammonia, alcoholic preparations, etc., have been long used to arouse the action of the heart, and effect the restoration of a proper temperature, where this is below its proper grade, as in the algid forms or stages of fever, in syncope, lightning stroke, shock in general, drowning or other modes of asphyxia. The use in fever of all those methods known as "cooling," such as emetics, purgatives, especially the salines, antimonial preparations, aconite, and local or general blood-letting, distinctly indicates an intuitive perception that remedies which retard the activity of the circulation, diminish general and local excitement, and thus directly reduce the existing grade of temperature. No remedies however of this class known in the last generation, have any direct action upon the heart, with the probable exception of aconite, whose agency in this direction is by no means certain or always recognizable, even in the midst of the general depression which it produces. Blood-letting is of course the most conspicuous of them all, but is soon followed by a recurrent rapidity of circulatory action, and not by any means always or even often at command, being emphatically contraindicated in nearly all idiopathic fevers, and in yellow fever most so of any. In this connection, consequently, it is well to note to what extent the practitioner may judiciously interfere with these great functions of calorefaction and circulation in fever generally, and a word or two with respect to the true nature of the febrile process, I am sure, will not be out of place.

Fever is a reactive mechanism—as strictly so as digestion, inflammation, hypersecretion, coughing, sneezing, the contraction of the parturient uterus, or any of the grouped acts of the animal economy, "pathological" or "physiological." A reactive mechanism, or "reaction" (I do not speak now of the "reaction" of the febrile process—a term which merely foreshadows the essential nature of the whole febrile process, including the *chill*)—

comprises and implies the harmonious and simultaneous action of several functions, specially grouped together in accordance with the original plan and purpose of each, whose final result, when the reaction is *successful*, is to remove or counteract the direct or remote effects of any impression arising within the economy or acting upon it *ab externo*, which in any degree assails its integrity or tends to disturb its prevailing grades of activity beyond what is compatible with the perfect action of each and every function. Without allusion to the physiological reactions, which are nothing more than the common habits of life, we find by this definition, that the animal economy is so constructed, that it instantaneously recognizes the presence of an injurious impression, and is able to establish, by virtue of its own inherent provisions therefor, a definite train of phenomena, local or general, or both, whereby the injurious assault made is neutralized, the offending object cast forth, or the injured and separated parts of its framework repaired and reunited. The *conservation of life* consists in unremitted reactions of infinite variety against all modes of natural action which are hostile to it.

I have already stated that the normal processes of nutrition are essentially of a fermentative character, and as the febrile mechanism is no more than an exaggeration of the normal nutritive processes in insurrection against a lædent condition diffused through the economy, it necessarily follows that in fever every action is stamped with a fermentative activity more pronounced and often very greatly or even inordinately so, than in health. What now is the cause of this increased fermentative commotion proper to fever? It is the dissemination through the economy, by the circulation, of fluids whose normal fermentability has become exaggerated either by stagnation, as of lymph in inflamed parts and regions, or even in all the lymph spaces and radicles of the body, in consequence of defective nutrition and innervation, or the direct inhalation or introduction through wounds or otherwise, of septic or zymogenous matter from without. Being generalized within the economy, these ferments impress each and every part with their own proclivity towards a grade of fermentative action, and even a mode of it, quite different in degree and kind from that to which the system is habituated, and so fall under the category of *lædentia*. The *lædens*, therefore, of fever, the injurious agency provocative of the reactive mechanism we call fever, is an excessive disposition towards fermentation—towards

molecular disintegration, tending to early exhaustion and destruction of the economy, by an unnaturally rapid metamorphosis of each and every tissue, begotten by the entrance into the economy in the class of cases under consideration more particularly, of septic zymogenous fragments of organic matter, living or dead, themselves undergoing rapid zymotic change. To neutralize this inordinate disposition towards change now set up in the economy, and to prevent the attendant engorgement and obstruction of the organs, to supply the excited tissues with the far greater quantity of oxygen they demand, to oxydize the excited constituents of the fluids, which will surely break up in putrefaction if they fail to receive the amount of oxygen they require, to supply the excited organs with the fluids from which they are now deriving their secretory pabulum in unusual abundance; to stimulate the function of respiration so that oxygen may be more abundantly supplied than ever; to exaggerate the action of the heart, and thus waft the nutrient fluids to all parts with adequate haste, and to exalt the temperature up to a certain point upon which every action depends for ultimate success, is the object of this general grouping of all the organic functions in the mechanism of fever.

But if an exaltation of temperature is necessary for the success of this reactive mechanism, can it be proper to diminish the temperature materially in our efforts to remove the state we call a morbid one? Are we really aiding nature by lowering the temperature? The answer to this is suggested by the definition of the febrile state, viz., a slight exaltation of temperature is always necessary, and is indeed essential to the success of the febrile reaction, and will exist in the cavities of the body in spite of all we can do. No measures should, therefore, be instituted looking to a reduction of the temperature quite to the normal standard in the early stages of fever, as by its very essence fever requires an elevation of temperature of a degree or a degree and a half above what is normal, for the perfect accomplishment of its unusual and difficult tasks. This I have found to be true by direct and constant observation. But inasmuch as under a great variety of circumstances the heat-forming processes are unduly active, especially where the zymogenous power of the septic cause of the fever is exceedingly intense, or the system has undergone previous changes, constituting what is known as predisposition towards fever, whenever this is the case, as a great rise

of bodily heat is fraught with the utmost danger to every one of the actively competing functions, measures should be taken to reduce the temperature. By doing so the following objects are effected :

1st. As each unit of heat represents the destruction of an equivalent weight of tissue by preventing an unnecessary generation of heat, the solids and fluids are conserved, and exhaustion postponed or prevented.

2d. As the exhaustion begins first in the heart, where action is of paramount importance, a reduction of temperature by rendering its beats slower and allowing the organ to rest or *sleep* during its diastole, as it naturally does, enables the heart to act longer and more efficiently than it could otherwise do, and so tends directly to the perpetuation and prolongation of life.

3d. As a high temperature directly enhances the rapidity of those fermentative changes which are so extraordinarily pronounced in fever, and thus causes a disposition toward sepsis, and in more moderate degrees of retrogressive change, to fatty degeneration, especially in the heart, whose excitement is greatest, and whose action is most constant, a reduction of temperature obviates the general disposition towards what we call malignancy, and foremost of all, to death by cardiac asthenia.

4th. In consequence of the abnormally high temperature, the natural processes of secretion, especially those advancing in the liver, are inordinately enhanced, and the transformations occurring in the blood and tissues at large greatly accelerated, under the impulses of the general zymogenous impressions pervading the economy. Moreover, as certain of these processes are not only stimulated but likewise simultaneously perverted, the emunctory or eliminative functions are inadequate to remove either the noxious products resulting from vitiated secretion, or the abnormal quantity of those naturally present, which thus accumulate in the blood, and intoxicate the nervous system or are diverted injuriously to special organs. A reduction of temperature obviates all this to a very great extent, or even to a point wholly within the limits of functional power.

5th. Mental alarm, nervousness, pain, and a disposition of various organs towards congestive stasis, or even inflammation, are directly obviated or annulled by a judicious reduction of the temperature.

Such is the signification of the rise of temperature proper to fever; such are its results when excessive, and the advantages of its reduction to a point compatible with the perfect accomplishment of the febrile reaction, and at the same time devoid of the risks of "hyperpyrexia." There is, however, another aspect of the first importance in which fever must be considered. An exalted temperature is merely an accompaniment of the febrile process, as it is of any enhancement of nutritive activity within normal grades, either local or general, or of the local reactive mechanism which we term inflammation. *Fever does not consist in the rise of temperature*, which is the result of the increased activity of organic action, and our therapeusis must constantly bear in mind, that by a reduction of the temperature we are aiding nature only in so far as we diminish functional activity by reducing the grade of its exercise within moderate limits. *The essence of the febrile state* is very simply the undisturbed persistence of the lædent or abnormal condition of the fluids and solids due to the development in them of a grade of fermentative disposition wholly beyond that to which the system is accustomed, and no doubt quite different, especially in fevers prone to malignancy, from that which characterizes the action of the economy in its usual condition. This condition belongs to every atom of the body, being generalized throughout it by the blood, and must be held to affect every organ whatsoever. The various solids thus impressed, are prone to individual reaction of a local character, and evince this by the readiness with which inflammation is established in them in all fevers of grave character. While, therefore, the general lædent condition of the blood provokes the systemic reaction we call fever, the influence of this condition, as affecting the solids, is such as to give rise to all the gravest dangers of fever, viz., proliferative action of important organs whose affection in this way obstructs the general movement, interrupts the harmony of the reactive phenomena of fever, and by preventing the final success of the reactive mechanism, destroys the entire economy. To this, fever is ever prone, as the disposition thereto is inherent in its very nature, and is notably fostered by the general dilatation of the vessels so pronounced in what we call congestive fevers, but which is really a proper feature of the febrile condition. Did no congestions and inflammatory obstructions of the organs occur in fever, the reaction would invariably succeed, except where the temperature mounts to a height at which, as in sunstroke, explo-

sion of nervous force occurs, followed by fatal shock. To prevent these congestions, and to remove them when occurring, is therefore one of the paramount indications in the treatment of fever—one, indeed, far more important in grave types of fever, like yellow fever, than the reduction of the temperature itself, which it is, however, essentially necessary to accomplish at the same time, inasmuch as a high temperature directly promotes this dangerous proclivity of the primary viscera towards fatal obstruction. But inasmuch as the temperature is only a condition and result of fever, and in no essential way inherent in the process, any more than in inflammation, however useful and inseparable from a rational treatment of fever such a reduction must be, it can never take a rank in the treatment of fever higher than that of a most important and indeed fundamental process of alleviation, and to a limited extent of prevention, of the dangers we are speaking of. Mere reduction of the temperature, quite adequate to restore health in fevers of moderate intensity, where no organic complication shows itself, will ever be found incompetent in the grave fevers of the kind we are considering, especially in view of the fact that in many of the worst types of *these fevers the temperature is but little enhanced*, and *even occasionally not perceptibly so.*

The primary indications in the treatment of fever are consequently two in number, viz.: 1st, a reduction of temperature, and 2d, the prevention and reduction of visceral congestion and inflammation. The methods of fulfilling these indications are now to be considered. They are likewise two in number, viz.: 1st, abstraction of heat by cooling liquids applied to the surface and taken internally, as a means of withdrawing heat already formed, and to some extent of controlling its generation, and likewise of anticipating the visceral engorgements by the general abatement of nutrient activity attendant upon a decline of temperature, and 2d, the systematic and continued administration of the only remedy we possess capable of accomplishing the desired results, viz., veratrum viride, with the objects of reducing the activity of the circulation and abating or annulling undue visceral activity, and thus lowering the temperature, while at the same time the abnormal flow of blood to and through the organs is prevented, and the characteristic tendency of fevers of a grave kind towards stasis in important viscera, is obviated or annulled. The use of quinine in continued fevers falls likewise under this category,

which also includes various alkaloids whose action is similar to that of quinine. The antiseptics, such as salicylic and carbolic acid, the hyposulphites, etc., act, I think, by affecting the hepatic functions and by lowering the general fermentative disposition of the fluids of the body, which quinine also does, in part, in view of its indisputable antiseptic properties. None of these remedies have any action upon the pulse, upon which it is possible to rely in a disease of such rapid progress as yellow fever, though of great value in various other forms of fever, and of some utility in milder cases of yellow fever, both in the progress of the case and when administered later, to hasten convalescence and prevent relapses; here they find their true place in the treatment of yellow fever.

1st. The use of cooling fluids to the surface, in all grades of fever, when the temperature runs too high, has of late years been so thoroughly tested and so copiously written about in current medical literature, in its several modes of cold affusion—sponging with cool water, or even tepid water with fanning, cool bathing, graduated or not, and systematically repeated, in conjunction with the administration of cooling drinks and ice—and the profession in general is so well informed upon all these points, that a bare mention of these various systems will suffice. The final objection to the exclusive use of cold water, or of cool or warm evaporating fluids applied to the surface, is its inefficiency. However invaluable as adjuvants to other measures in mild or even grave forms of fever; however useful in fevers which, like rheumatic or typhoid fever, admit of a frequent repetition of the baths, from the fact that the normal duration of the febrile period is counted by *weeks* instead of by *days*, as in yellow fever, they are wholly inefficient in yellow fever when used to the exclusion of other modes of medication. They are so, to a greater or less degree, in all the modes of fever to which they are exclusively applied, for the following reason: Heat is thus abstracted from the surface and extremities, the skin is cooled, the internal organs are also reduced in temperature to a very considerable extent, the frequency of the respiration and of the heart's action are diminished very greatly, and even reduced to nearly their normal grade; but no abiding influence remains—the processes whose activity has been temporarily abated renew their activity within a short period, and a repetition of the bath or a renewed copious effusion becomes very soon indispensable. Be-

sides this, when the fever runs high, the temptation to lower the temperature too much is almost irresistible, for if this is not reduced to its normal grade or even below it, it rises so quickly again that almost continuous immersion is requisite. So low a reduction of the temperature in fever is wholly contrary to proper practice, for the temperature should never be reduced entirely to the normal grade, and most certainly not below it.

Moreover, another insuperable objection to the practice in yellow fever is found in the consideration that the quantity of blood attracted to the mucous membranes, the glandular and nervous and muscular viscera is not only *not diminished*, as it should be, in the effort to reduce the grade of nutritive activity everywhere, but is actually increased by the chilling of the extremities and skin. This effect of the process is fraught with exceeding danger in all fevers where there is a natural disposition towards a passive congestion of internal organs; and, although if of good natural type, such organs may bear the unusual blood pressure well enough in the early days of the fever, a little later the latent disposition will be surely and fatally enhanced thereby. Experience has fortunately settled the impropriety of the use of ice-cold water, of packing in wet sheets dipped in ice-water, and of all similar drenching of the surface with cold fluids in yellow fever. In 1852, the practice of packing in wet sheets dipped in ice water was faithfully and laboriously tried by Dr. H. A. Desaussure, in Charleston, S, C., and the method was unequivocally condemned by him. In 1854, I packed a yellow fever patient on the first day of his attack, the fever running extremely high, in iced sheets, after a similar method, and although the patient was up the next morning and actually went out of the hospital, he returned three days afterward with so malignant and congestive an attack, that I did not venture to reapply the packing, and he died after forty-eight hours. Another patient who had been sick three days, was packed in ice-sheets by one of my fellow internes, against my advice, and he died in a congestive chill the same evening. Anything short of continuous reduction of the temperature by the use of ice, as an exclusive or basic method of treatment, is utterly inefficacious in so short and violent a disease as yellow fever, and to depress the temperature so greatly and in such a way is quite improper, while, as I shall show, when used in concurrence with measures competent to abate the activity of the heat-making processes and to prevent

and relieve the congestion of the organs by retarding the heart's action and constringing the small arteries, the use of cool applications to the surface is of the first importance.

As a basic method, therefore, of treating yellow fever with a view towards a reduction of the temperature, the use of cold baths or continuous affusions of cold water, is wholly ineffective, because the deeper organs cannot be sufficiently cooled without too great and too prolonged, and consequently very dangerous cooling of the extremities and surface, and because every such system is naturally devoid of any power whatsoever to lessen the quantity of blood already accumulated in the passively congested organs, and is liable to the fatal objection of increasing the disposition towards parenchymatous stasis, which is so inherent a feature in yellow fever.

Is there now in the second place, any remedial agent whereby we may certainly control the quantity of blood sent to the various organs, diminish the existing congestions, and lower the general temperature to a proper grade without recourse to systems of external cold affusions? I answer there is, and we find it in the employment of the veratrum viride, which is the only drug in the pharmacopœia possessing these wonderful qualities, while at the same time thoroughly reliable and devoid of danger.

Veratrum was first prominently brought before the profession, in the year 1857, by Dr. W. C. Norwood, of Cokesbury, S. C. It had been used with no remarkable effects, if not very judiciously, in pneumonia, typhoid fever and some other diseases. In June of the same year, I was called in Charleston, South Carolina, to attend the first case of a localized epidemic of typhoid fever, which was followed later in the season by a number of cases simulating yellow fever very closely, some of which were undoubtedly true yellow fever occurring in partially acclimated persons; yellow fever was then prevalent on a limited scale in the city. My first two cases were treated with cold spongings, affusions, mild mercurials, and quinine in large and frequent doses. They both died. Other cases very soon occurred, and I was compelled to adopt a wholly different practice. Under the influence of the views respecting the nature of fever, and the indications to be fulfilled in its treatment already set forth, which I had very distinctly defined at that time, I determined to employ the new drug, as a basic remedial agent in fever.

The veratrum was administered in doses varying from one to

four or five drops, according to age and other conditions, and small doses of calomel or blue mass were given occasionally.

The diet was beef tea, milk and lime water. No quinine was employed. Occasional spongings with cool water were practiced and ice permitted *ab libitum.* The veratrum was administered night and day, in doses adequate to maintain the action of the heart at a rate not more that twenty nor less than ten beats below the normal standard, and this was continued until the tongue began to clean, and when, upon the intermission of the veratrum for six hours, no disposition of the pulse to rise above the normal standard was perceptible. This was all that was done.

When the doses of veratrum were too large, or given too frequently, the patient vomited, but I soon became able to graduate the doses so as to avoid this almost entirely, or even altogether, and the attendants, seeing the abatement of temperature, the mitigation of all pain, the total absence of the furious delirium, the hemorrhages, the diarrhœa, the dry tongue and inappetency, which they had witnessed in the earlier cases, ceased to fear the attacks of vomiting, which they learned to relieve with a little coffee or a spoonful of brandy.

I lost none of these cases, and by the end of the season had acquired a new experience in the treatment of fever, and had become more or less of an expert in the art of administering veratrum.

From that day to the present time, I have used veratrum as a basic treatment for every variety of febrile motion, not excepting the exanthemata and hectic, and as a means of arresting the congestion of various organs, preventing abortion, subduing facial erysipelas, and preventing the recurrence of secondary hemorrhages, during the war. In the violent congestive forms of malarial fever of the Southwest, in which I have had a long and extensive experience, I have used the drug with effects that almost relieved my mind altogether as to the fortunate issue of any special case. And at present, it is my universal practice to employ it, wherever a fever exists that is worthy of serious attention, and to trust to it, and not to quinine, to subdue all cases of remittent or similar fever, using quinine only after the fever had been persistently held in check for two or three days. Finally, I have frequently taken the drug myself, and constantly did so while suffering at the South from chronic malarial fever, to mitigate the fever coming on after a chill.

Having met with so gratifying a success in the treatment of various fevers in 1857 by the use of veratrum as above sketched, I was naturally anxious to apply it to the treatment of yellow fever during an epidemic.

I therefore spoke of the matter to several of my friends, who were in general interested in the results attained, and hopeful of its success in yellow fever, but as I wished to make a very thorough trial of it and to treat a large number of cases, so that the matter could be fully tested in every way, I determined to join forces for the summer with one of my fellow practitioners and to treat all cases in this way in our joint practice. Among others, I mentioned this project to Dr. Octavius A. White, now of New York City. This gentleman was sagacious enough to see the points at once, and we promptly closed with the understanding that I was to treat the first case of yellow fever that should occur, either in his or my own practice, in this way, and that if the case succeeded, that we should then continue to use veratrum in the way I had proposed in all cases that presented themselves, and publish the matter in due time over our joint names. We did not wait long. The first case occurred in Dr. White's practice, and upon notification, I at once took charge of it, and in three or four days dismissed the patient convalescent. Unfortunately I have lost the notes of this case, but have preserved those of the second one occurring to us that season, which I here copy in partial illustration of my practice:

Mrs. Brunsen, æt 32; German; plethoric; had been attended by Dr. White for yellow fever with black vomit, and even parotitis, in 1854, residing, then on Spring street. At present resides at the southwest corner of Church and Cumberland streets, in the next house but one from that in which Case I occurred.

August 18th, 1858.—Dr. White saw her for the first time at 8.30 P. M. Found her presenting all the symptoms of yellow fever, but did not incline to believe her case could be such, knowing of her attack in 1854.

Dr. White orderered calomel grs. xii, and Hirud: No. ij to the temples. Pulse 84. Having requested my attendance, I saw her with Dr. White, at 11 P. M., two hours and a half afterwards. Hot skin; restless and confused; eyes much injected; whole physiogomy inflated; tongue covered with creamy fur and moist. Leeches had drawn well. Diffused headache; pain in the back and limbs; had had a chill in the morning at 10 A. M, and

first went to bed at 5 P. M. Since 5 P. M. has vomited twice; nausea; pulse 100. No further prescription.

August 19th, 2 P. M.—Calomel had acted twice; decided to use veratrum viride; condition otherwise the same; in consequence of the action of leeches, and imminent operation of the calomel, the pulse had sunk twelve beats; now 88. Ordered: 7 drops at 2 A. M., 7 drops at 3 A. M. and 7 drops at 4 A. M. 4.45 A. M.—Has not vomited the doses. Had been asleep for an hour; skin somewhat cooler; headache less intense. Pulse 72. Ordered: 7 drops at 6.20 A. M. 7.30 A. M.—Had been asleep; feels oppressed and somewhat uneasy (influence of drug); skin notably cooler, moist; tongue moist; headache less; nauseated; (drug) Ordered fl. iij coffee with milk. Two more actions since last visit; pulse 52; no more drops.

11:30 A. M.—Skin natural; had vomited a little bilious matter as well as coffee; some epigastric oppression; *no headache* or *pain*. Ordered: Arrowroot with a tablespoonful of brandy. Pulse 44; no more drops. 3 P. M.—Entirely calm; had been sleeping for an hour since one o'clock, after taking one-half the arrowroot and brandy. Skin quite cool; no uneasiness of any kind; another evacuation; pulse 52; no more drops. 7.30 P. M. —Condition the same excepting slight pain in the back and slight headache; had slept from 6 to 7 o'clock; pulse 60. Ordered: ver. vir. gtt. iv, for 9 P. M. 11 P. M.—Had taken the four drops at 9 P. M; asleep; perfectly composed; wishes to get up in the morning; no uneasiness except a slight pain in the back, probably from recumbent position; skin quite natural; pulse 64. Ordered: 3 drops for 11 P. M. and the same for 1 A. M.

At 12.30 A. M. (Aug. 20th,) to begin with a saline diuretic mixture, and to take two grains of calomel with three of rhubarb every fourth hour.

Aug. 20th, 2.30 A. M.—Has taken her drops at 1 o'clock; asleep; quite easy; continues her other medicines; pulse 64. Ordered: 6 drops at 6 A. M. 7.30 A. M.—Has taken her drops; quite composed; asleep when I called; quite easy; no nausea; skin entirely natural, and neither drier nor moister than normal; tongue does not show any sign of cleaning, without which the disease must still be considered as lurking in the system. Eyes pale, and very little tinged; only so in the conjunctival sulcus; continuation; pulse 60; no more drops. 11 A. M.—As before, no nausea, even upon taking medicine. No action of bowels;

has passed urine; continues medicines: conjunctivæ very slightly tinged in sulcus; pulse 64. Ordered: 3 drops at 12 M. and at 2:30 P. M."

The pulse was steadily maintained in the neighborhood of 60 for three or four days and the alkaline diuretic mixture continued, moderate doses of quinine being also given until convalescence was fully established. The mercurial was administered some forty hours; no ptyalism ensued. The re-establishment was prompt and uncomplicated.

Six or seven cases consecutively treated in the same way recovered promptly; at last we had a death. This case was one of frightful malignity, the patient residing within fifty feet of a tomb in St. Phillip's churchyard, in which dead bodies had been deposited very lately, in all the heat of August, her room being *directly over* an old privy, whose concentrated ammoniacal steams irritated my eyes even in the chamber of the patient, while the odor was absolutely intolerable. In this case the pulse rebelled on the second day, and the patient died with black vomit on the third. After this, nothing daunted, we continued to use veratrum in every sthenic case, and in a variety of cases where, although local and general congestion was marked, there seemed some chances for the patient. No case was refused, and our practice, as young men, lay almost entirely among the poorer classes, and two-thirds of it under the supervision of the Howard Association. By the close of the season we had counted 186 cases treated by veratrum, with fifteen deaths—a mortality of just eight per cent. The number of blacks and children was quite small, and the patients in nearly all cases unacclimated—Irish, Scotch and Germans. The veratrum practice was thus put to as thorough a test as could be possibly desired, for such a number of cases treated in any single way is, to my knowledge, quite unusual in yellow fever or any other disease. Dr. White found in fifteen or sixteen cases, outside of the above number, that tincture of gelseminum could be also used as a "bradycrote," a term I desired to apply to the treatment of fevers generally by this method, in view of the *slow pulse* which is essential to success. The results of our joint practice will be found in an analysis of our cases published in the November number of the *Charleston Medical Journal* for 1858.

The treatment of yellow fever is greatly affected by the several modes of the affection which I have adverted to above, so

that it becomes necessary to consider each of the conditions affecting the course and prognosis of the disease in a brief detail. I shall, therefore, in the first place, proceed to sketch the method of using veratrum in yellow fever where the fever is marked or runs very high.

When the temperature is elevated and the action of the heart pronounced—in other words, when the reactive or primary stage of the disease is well developed, our first object must be to abate these conditions, and so, by conservation of the nervous forces, and by preventing premature exhaustion of the heart, to prolong life until the powers of nature are able to restore a normal balance. In this form of yellow fever, consequently, which is happily most frequent of all, art can effect more by far than in any other. No remedial measure can compete with veratrum viride in ability to effect what we desire, and the treatment must be early, vigorous and most watchful. There is no disease where the assiduous care of the practitioner is more urgently demanded than in this. His visits must be very frequent, barely five or six hours apart in heavy cases, often more frequent even than this, by day as well as by night. The entire period of the disease in which benefit of the kind supposed can accrue is limited to three or four days, and entirely to the primary or reactive stage. The system of treatment ought to be as follows:

If the attack has come on shortly after a meal, the stomach should be evacuated by an emetic of ipecac, not necessarily encouraging emesis, and as soon as possible afterwards a mercurial cathartic should be prescribed. Eight or ten grains of calomel, with a scruple of rhubarb, will be active enough. A standard prescription is, calomel, grs. x, pulv. jalapæ, grs. xx, and potass-bitart, grs. xxx, in four powders, one of which is to be given every hour until the bowels are moved properly—that is, rather copiously. We must not wait, however, for the action of the purgative before having recourse to veratrum. Let this be begun almost simultaneously with the administration of the purgative, as soon as we see the patient, unless the indications for the exhibition of an emetic are direct, and in this case within an hour afterwards. We must begin with the veratrum at the earliest possible moment, and must bring our patient fully under the influence of the drug within six or seven hours. These indications are absolutely peremptory with the heaviest cases, and should be practiced even in the lighter grades occurring in unacclimated

persons. In an adult, therefore, who is in the first stage of his disease, we begin by prescribing seven or eight drops of Norwood's tincture, if a male, and from five to seven, if a female, *every hour*, until vomiting occurs. Usually four such doses are adequate to affect the pulse, which becomes, at this time, somewhat excited, while the patient feels oppressed and a good deal disturbed. After the third or fourth dose he vomits, sometimes profusely, and breaks into a copious sweat. Occasionally the vomiting is quite severe, but at other times by no means worse than the action of a mild emetic. In many instances, especially where the quantity of veratrum has not been so great, vomiting is absent altogether. Experience soon teaches the practitioner to adjust his doses so that vomiting is seldom very severe. The vomiting, however, must never be feared; it is a sure sign that the systen has been impressed by the remedy, and is altogether salutary in its effect. It is a pure blunder to apprehend the ejection of black vomit in veratrum vomiting in the first stage of yellow fever; black vomit cannot possibly occur at this time, and is in no way excited nor hastened by the use of veratrum, which is indeed the most powerful agency we possess in preventing and postponing it.

When the primary vomiting is excessive, the intellectual faculties are benumbed, the patient is prostrate, the tip of the nose, cheeks and skin are blanched, for the constringing effects of the drug upon the small arteries are now pronounced. In the worst cases, even sight and hearing temporarily fail, and the attendants, sending hurriedly for the physician, expect to witness the dissolution of the patient. There is never the slightest cause for grave alarm in this "cephalic veratrism." In an extraordinarily extensive experience in the employment of veratrum in fevers, I have been sent for some dozen times to witness a condition like this, but have nearly always found my patient much better when I arrived, and often in a very satisfactory condition. If the symptoms still continue, I inform the friends that there is no danger, direct the administration of a tablespoonful of brandy with a half teaspoonful of aromatic spirits of ammonia in water, or in a mouthful of strong coffee. Generally he recovers himself after a half an hour. There is nothing whatsoever to fear either in the gastric or cerebral forms of veratrism. Let the friends of the patient and the patient himself be forewarned of what may follow, and let them be advised what to do if the vomiting

or temporary prostration should prove excessive. The practitioner will know, on his part, that he is about to assume a mastery over his foe, which nothing in the pharmacopœia but the drug he uses can so surely and safely accomplish.

When the fit of vomiting is over, the patient recovers his composure and *sleeps*. The pulse is now found to beat at a considerably lower standard; instead of 100 or 115, it is now 80 or 70 per minute. The temperature has also fallen. The patient is more comfortable and his pains are greatly diminished. The sighing and anxiety are greatly lessened. An hour, to an hour and a half afterwards, the symptoms have still further abated. Let now another dose of veratrum be ordered, to be taken two hours after the last one, and again another, two hours after this.

If the physician returns six hours after his first visit, he will find his patient in the following condition. The flushing of the face has disappeared, and with it in great part the injection and ferrety redness of the conjunctiva. The features are natural, instead of swollen and turgescent. The pains in the head, back and limbs have disappeared as if by magic. The thirst is gone. The restlessness has given way to composure and the patient will nearly always be found *asleep*. The temperature will be found at 101 to 101 ½ instead of 105, or 107. The pulse will beat at 52 or 64, instead of at 100 to 115. The patient will desire food and say that he feels quite well again, when awakened. Food however he must not touch, nothing whatsoever but ice and cool water. The quantity of this must not be limited; let the patient have as much as he will in moderate quantities at a time. Prescribe for him now a couple of grains of calomel with two or three of rhubarb, every two hours, to be continued for forty hours. The bowels, naturally disposed toward constipation, will move occasionally but not profusely, and no salivation will be produced, at least I have never seen it, in cases so treated of yellow fever. But the main object to be fulfilled is the maintenance of the command over the circulation, temperature, and visceral circulation, we have now acquired. For this purpose, it is requisite to continue the use of veratrum, pro re nata, day and night, until the tongue begins to clean, which it usually does, in cases so treated, about the fourth or fifth day. Whenever the pulse rises above 65, a dose of veratrum, say 6 drops, or even 4 or 5, should be given, and repeated in an hour and a half. Our object must be to maintain the rapidity of the circulation at a rate from ten to fif-

teen beats below what is normal. Let the physician take the drug with him, and drop out the doses with his own hand, into separate wineglasses, and place each glass on a slip of paper on which he notes the time of administration. In every instance the physician must forecast every dose, and always return, not longer than two hours and a half after the last dose. The effects of a dose of veratrum lasts about two hours and a half, and proportionately longer day by day as the patient improves. On the first day of treatment, and perhaps on the second, the doses must be given at intervals never longer than three hours apart. The pulse, once reduced, must never be allowed to rise again. If it does so, the circumstance is of bad prognosis and in its effects is of the nature of a *relapse*. The organs whose congestion had been lately relieved, are now once more repleted, their original congestion re-established, and all the evil train of symptoms set in motion anew. Nothing can be more unfortunate, as it is doubly difficult to reduce the pulse, when by neglect or accident it has been allowed to rise again, and the febrile movement, lately abolished, has been set in motion once more. The utmost vigilance in this respect must be practiced for several days, and until we find that the doses of veratrum, now reduced nearly to one-half of what was at first given, can be postponed through periods of from five to six or seven hours. The administration of the veratrum will then have become a simple matter.

The doses are left by the physician and are administered by the nurse in his absence, while no ill results follow if they are not given within an hour or two of the time appointed.

The patient may be said to have begun to improve since the first throttling of the fever, for this is a true instance, if not of the jugulation of disease, at least of something more nearly akin to it than anything outside of surgery. The temperature varies a little each day, being generally somewhat higher in the afternoon, but seldom exceeding 102 ½. When this is observed, the use of cool sponging finds its appropriate place, but must be very moderately practiced. The skin under the employment of veratrum is usually dry, but not invariably so. To remedy this, I have employed jaborandi, drop for drop with the veratrum, and have been greatly pleased with its results. The details of two cases treated in this way will be found in the Committee's report. This is the only way in which jaborandi ought to be used in yellow fever. When given later, the diaphoresis is too weakening,

and is without the least power to control or modify the septic processes now hastening to overwhelm the patient. When, however, jaborandi is given early, and in the moderate doses named, associated with veratrum, gentle perspiration is induced without noticeable ptyalism, and if the patient is lightly covered, as should be the case, the evaporation of the sweat, aided by gentle fanning, which is very grateful, notably reduces any disposition towards a rise of temperature.

As long as the diminution of the pulse consequent upon the administration of a dose or two of veratrum continues for two hours and a half, *or for a longer period*, we know that our patient will surely recover. I have never known any exception to this remark in yellow fever, and in typhoid fevers but once or twice, where perforation of the intestine or accidental hemorrhage carried off a patient who would have otherwise recovered. In about four or five per cent of cases of yellow fever, even of the most violent sthenic type, however, we find that veratrum fails to affect the pulse for the period alluded to. Although the pulse falls after three or four doses at first, or after a fewer number later in the treatment, it does not remain reduced for more than an hour or an hour and a half, and an obvious disposition toward a shortening of the interval becomes manifest as the disease advances in its hasty march. This is of the worst possible prognosis; all such patients will surely die. This is obvious when we reflect that veratrum acts on the heart and arteries through the nervous system by a powerful stimulation of the inhibitory nerves, and that the center whence these nerves arise must be comparatively unimpaired, and the nervous system generally possess a certain degree of responsiveness to excitation, for the action of the drug to be manifested and maintained. This signifies that the economy is not yet wholly overborne nor intoxicated. But when, either as a characteristic of the stage of the malady, or from natural weakness of constitution, or from most unusual intensity of the morbid actions underlying the disease, the responsiveness upon which veratrum must act, does not exist, or is greatly enfeebled, the impression produced by the drug is fleeting, and it is hopeless to attempt to elicit it by increased doses or more frequent administration. This I have been sometimes tempted to do, but have never found it end in anything but failure. The pulse rebels against the remedy sooner and sooner, and must be discontinued. What is to be done at this

critical point? a moment that must be always looked for and that will surely be encountered in a certain number of cases. As the explanation above given of the action of veratrum sufficiently shows, there must be an immediate and total change of treatment. All has been gained that is possible in the way of conservation of force, and we may very well begin to draw upon the powers which we have to some extent accumulated in the system even under such unfavorable conditions. The veratrum must be discontinued, and stimulation begun, with iced champagne or brandy and soda-water, with quinine and capsicum and preparations of ammonia. The skin should be strongly counter-irritated with mustard, and the use of all cold applications discontinued. A little beef tea and milk and lime water may be allowed if the stomach will tolerate anything. In a small portion of such cases success will attend these measures, especially in acclimated persons, to whom I have given as much as fifty ounces of brandy within thirty-six hours after discontinuing the veratrum. But I must say *that more than three-fourths of such cases*, occurring in non-acclimated persons, especially in the early periods of an epidemic, will die in spite of all that can be done.

When the tongue begins to clean around the edges, it is proper to prescribe an alkaline diuretic mixture, containing acetate of potassa, tinct. squills, sweet spirits of nitre, and some digitalis. Ten or fifteen grains of quinine a day will also hasten the recovery and prevent a relapse. The diet should always be absolute, until the tongue shows symptoms of cleaning. About this time a light purge of castor oil or other gentle aperient should be given to clear the intestines of much offensive matter, sometimes even of hemorrhagic character, which has accumulated in them. After this the patient makes a rapid recovery, and returns to his affairs in a week or two. There are no sequelæ whatever. No long train of carbuncles, ulcers, chronic prostration, or other conditions of protracted convalescence, so commonly seen after yellow fever treated in other ways, is ever observable after a well managed and successful case where veratrum has been given.

Let us now glance for a moment at what it is proper to avoid in the treatment of a typical case of pronounced yellow fever occurring in an unacclimated person.

1st. Never prescribe opium or any of its preparations, and this for the two following reasons: First, because opium directly diminishes that responsiveness of the nervous system upon which

the action of veratrum depends, neutralizing its constringing influence upon the small arteries; this induces a return of general and local congestion, undoing all that veratrum has effected, and directly promotes the gravest conditions peculiar to the disease.

2d. Because there is never any indication for the *employment of opium* while we are using veratrum. The rest, ease and sleep, which would be sought after by the administration of opiates, are realized by veratrum in an almost perfect manner, and under circumstances where opium could never have effected anything of the same kind, either in degree or quality. Under veratrum, the patient has no pain, he does not toss, but lies quiet, asleep, or indifferent; he does not moan, sigh, or cry out, nor are the actions of the bowels excessive. Scarcely any of the local excitements, such as the nausea, vomiting, or rectal tenesmus, so often seen in yellow fever are observed, for all such phenomena depend upon local congestions and consequent excitation; in the general abatement of such conditions induced by veratrum, the stomach becomes quiet, not being provoked even by the drug itself, the bowels are composed, the bladder easy, and every function tranquilized in harmony with the circulation. There is consequently no necessity whatsoever for the use of opium or any other hypnotic when veratrum is employed, which is, indeed, the least harmful and the most powerful of all hypnotics, in febrile diseases. In fact it is my frequent custom to administer a few small doses of veratrum, even in preference to morphine, especially after surgical operations, and in delirium tremens in conjunction with chloral or the bromides, or even by itself; sleep is thus certainly produced, without any of the disagreeable effects attendant upon the employment of opiates.

I must condemn the use of opium in yellow fever, except in cases where the local congestions are not marked, or where there is but little proclivity thereto, as in the milder forms of fever which occur in the partially acclimated. Before the disease is plainly mastered, as shown by the disposition of the tongue to clear around the edges, opium is hurtful and far inferior in potency to veratrum for all the purposes to which it is applied. I must still more emphatically discountenance blood-letting, in all its forms, in yellow fever.

To withdraw from the circulation what is indispensable for the restoration of the normal systemic balances, to reduce the oxydizing and stimulant power of the blood, under conditions

where disease exists essentially begun amid such states and clothed with its very worst proclivities by their continuance, to increase a general hypo oxygenation, out of which, by tremendous efforts the economy is struggling to rise, is absolutely irrational in theory, and only fails to be universally a fatal practice on account of the unusual power of nature in certain cases. I have never bled but once in yellow fever, viz., in 1852, and my patient died. Since employing veratrum, I have never had any occasion even to contemplate such a practice. The relief from headache, convulsions, delirium, and from local pains, and the diminution of excitement accomplished by general bleeding in the time of Rush, and by scarified cups or leeches in our day, is far more certainly attainable under veratrum, and may be maintained day after day by the steady exhibition of the drug, while almost sure to recur after local blood lettings which few men dare repeat in our times. The abstraction of blood corpuscles, in any form of idiopathic fever, is in direct violation of sound therapeutics as based upon correct pathological knowledge. Veratrum enables us to lessen the amount of blood sent to the several organs without diminishing the absolute amount of blood existing within the economy, to reduce vascular tension without abstracting the contents of the vessels, and to lessen congestion or even abolish it, without diminishing the oxygen-bearing power of the blood, upon which the entire issue of the febrile reaction depends.

The symptoms usually regarded as indicating the local use of leeches or of scarified cuppings in yellow fever, are those which subside of themselves as soon as the pulse is reduced, and such a practice is consequently quite unnecessary, while at the same time of a most dangerous character. I have never cupped or applied a leech in yellow fever, or in any form of fever whatsoever, except the phlegmasial pyrexiæ, up to the present time, and I must unequivocally condemn the procedure as unnecessary and fraught with a danger which is directly proportionate in yellow fever, to the amount of blood withdrawn.

With regard to drink in yellow fever, nothing, as I have already hinted, is required but cold water and cracked ice. Barley water, rice water, and tisanes of various kinds so much employed, are apt to acidulate, to generate flatulence, and whatever nutriment they contain is quite unnecessary and distinctly injurious during the febrile stage. The ingestion of fluid in

moderate amounts is called for, however, as indicated by the thirst, and should never be withheld, especially as we should endeavor to stimulate the functions of the skin and kidneys. Such a diuretic as I have suggested is all that I have ever given, and all that can be of any avail. Jaborandi will produce a moderate amount of diaphoresis and diuresis at the same time, and the alkaline diuretic mixture above spoken of will stimulate the kidneys sufficiently. Under the veratrum treatment, suppression of urine is almost unknown, at least I have never seen it, and its mechanism, as due to passive hyperæmia of the renal tissue, belongs to the very class of conditions which veratrum most certainly obviates. When the pulse has been fairly reduced, on the evening of the second day or morning of the third, it is my custom to prescribe the diuretic mixture alluded to; but I think it unwise to attempt to force a diuresis through a kidney whose inactivity is not the result of *anæmia*, but of *stasis*, whose tubules are occluded by hyaline casts, and whose secreting epithelium is destroyed by disintegration and exuviation by any administration of diuretics whose power in but few cases is very distinct in yellow fever, though usually regarded as powerful of their class. Moreover, the employment of powerful diuretics in complete suppression of urine is almost universally unavailing—if we except a few recorded cases in the entire range of the literature of yellow fever, and of which I have seen but one example—while, on the other hand, if the suppression is but partial, milder remedies, in combination with hip baths and hot fomentations assiduously applied to the region of the kidneys, will restore the secretion, if the renal structure is not hopelessly disorganized.

With regard to the diet in yellow fever, I have but little to say, for as long as the tongue shows no signs of cleaning, and in all cases whose congestive character is unusually pronounced, the diet should be *absolute*. No food of any kind whatsoever should pass the patient's lips. Food is wholy unnecessary, and if absorbed, as but seldom happens, cannot fail to be injurious, for the system is already overborne, and the secretions necessary for digestion wholly arrested or perverted. Even after convalescence fully sets in, the utmost care is requisite in this respect. Only very limited amounts of the most easily digested material should be allowed, such as chicken-tea, and mutton broth. Farinaceous matters and vegetable substances, with pulpy fruits must be interdicted, as tending to excite flatulence and diarrhœa. A

little later, broiled mutton or tender steak in very limited amounts may be allowed, until the digestive powers, greatly enfeebled both by depravation of the tone in the general system, and the recent local stasis, have somewhat recovered themselves. When, however, after the second stage of the disease has passed, and hemorrhages occur of a passive character, or secondary febrile symptoms appear, consequent upon the kindling of local inflammations, as these phenomena are often very protracted in their course, such nourishment as is appropriate to enteric fever should be allowed, beef tea, and milk and lime water. More than this will do harm. A violation of these rules of diet, which are now universally acknowledged, will surely entail much distress to the patient, and in the majority of cases will cost him his life.

In children, the same general rules of practice should be applied which I have endeavored to explain for adults. An initiatory emetic of ipecac should be prescribed, and a dose of castor oil given afterwards. No strong purgation should be practiced; but, as soon as practicable, a grain of calomel mixed with white sugar and gum arabic, should be thrown into the mouth, in the dry form, every two or three hours, and so continued for two days. Veratrum should be administered at the earliest practicable moment, and if given with water is never objected to by children. Every dose must be distinctly ordered by the physician, and the primary reduction of the pulse effected, as in adults, by doses an hour apart. After this the period may be gradually extended. Very often these little patients do not vomit at all, and they generally take veratrum more easily than adults. As no age serves as an exemption to yellow fever, except, perhaps, a few months after birth, so also no tenderness of age constitutes a contraindication to the employment of veratrum. I constantly give the drug to children even four or six months old. In these cases, and in children generally, as well as in delicate adults, and whenever it is desirable to avoid the formality of measuring out the doses, or to keep an irritable, exacting, or otherwise unmanageable patient from knowing the nature of his medication, I have for many years past employed veratrum in the form of powdered extract. The prescription by which this is accomplished is as follows: The number of drops to be taken at each dose having been ascertained, the entire quantity of veratrum necessary for one or two days use is dropped by the drug-

gist upon a tile, and a quarter of a grain of camphor to each drop dissolved in the little pool. This is next spread widely upon the tile, and allowed to dry *thoroughly*. A proper proportion of ground white sugar, with a little aromatic powder, is now sprinkled over this, and the whole scraped and rubbed off with a sharp spatula. The mass is then divided into little powders or made into granules. Each powder or granule contains one dose of veratrum. The powders are to be cast into the mouth dry for both children and such adults as I have specified. They are of pleasant taste, and cannot be spat out by children. The nature of the remedy is entirely concealed, and the addition of the aromatics and camphor tend very notably to diminish the disposition towards nausea which so often attends the use of veratrum. I have been greatly pleased with this preparation.

A cardinal rule is to be followed in the administration of veratrum: After the primary reduction of the pulse, which may often (two-thirds or three-fourths of the cases) be effected without more nausea or vomiting than is characteristic of the fever itself, the doses of veratrum must always be limited to that amount which will produce the effects desired, without gastric or cerebral veratrism. We cannot afford to think too much about this in the primary reduction of the pulse in yellow fever, in the high grades, where veratrum is almost our only hope. It is so absolutely important that the disease be brought under control in the very shortest period of time possible, that the vomiting caused by the drug employed becomes a matter of comparative indifference. In yellow fever, indeed, the act of vomiting, in the early stages, is productive of benefit, though distressing. In other types of fever where the danger is not so great as in yellow fever, and where the natural course of the disease is more protracted, the primary reduction of the pulse should be extended over a period of ten or twelve hours; and with one skillful in the use of veratrum, vomiting should very seldom occur, and should even then be quite moderate. The practitioner will find that, day by day, he may gradually diminish the doses, and still produce the desired effect upon the system; but he must, above all other things, be careful never to allow the pulse to rise above the normal standard, or at least remain so, long enough for a reëstablishment of the fever in all its features. His patient will be greatly exhausted thereby; a second reduction of the pulse will be far more difficult to effect than at first. I repeat this,

for it is of primary importance. In a condition of pregnancy, women, who are not so liable to yellow fever as men, are peculiarly subject to the disease; and the prognosis of such cases is almost certainly fatal, nearly all cases aborting, with a certainty of a fatal termination. Veratrum should be administered to pregnant women in the same way as described for other persons, but care should be observed to adjust the doses so that vomiting shall not be excessive. When pains occur, as they are due to the hyperæmic condition of the uterus and to the general excitement, as in other fevers, it is not unusual to see them disappear when the pulse subsides; and in 1858, several women sick of yellow fever, in whom premature pains had set in, recovered from very severe attacks of the disease, under the administration of veratrum, in one case, after actual delivery. In yellow fever a pregnant woman will almost surely abort, and neither opium nor veratrum will stay the progress of the disease in the great majority of cases. But that any pregnant woman attacked by severe yellow fever should recover is a most uncommon occurrence, and one that happens more frequently under the use of veratrum than otherwise.

Partial or total acclimation notably affects the prognosis in yellow fever. Where this has been acquired by nativity and long residence, the disease is contracted late in the season, as a rule, the earlier cases being those of persons who have lived but a limited period in a city where the disease is prevalent, or are newly arrived. Unacclimated persons evince a special readiness to contract yellow fever. Indeed, a distinct gradation in this respect can be very clearly made out; those who are most liable to the disease, experiencing it in its worst forms, and soonest. Thus the Scotch are more liable to yellow fever than any other persons, and it is excessively fatal to them when unacclimated. Next in order, are the Scandinavians, Irish and Germans, natives of the Middle States of the American Union, and hill country of the South, the French, Italians, Greeks and Spaniards. The partially acclimated citizens are attacked much later, seldom indeed before the end of September and October, or even November, and the disease is not usually so severe. The distinct disposition is towards recovery, and it is in such cases, both in adults and children, that the small mortalities sometimes realized in the treatment of yellow fever, are met with. It is in these cases also that quinine in very heavy doses is productive of good results,

as used by Blair in Demerara. This drug, in combination with cool spongings and the use of gentle evacuants at first, of repeated doses of calomel for forty or fifty hours during the progress of the disease, and the judicious employment of stimulants in the second and third stages, will often suffice to effect a cure.

But it is also in these very cases that veratrum shows its superior powers. The cortege of congestive symptoms, as declared by the flushed and swollen face, the suffused and fiery eye, and windy pulse, characteristically present in the florid stranger, is seldom met with here. As the prognosis is so much more favorable, the mode of administration should be somewhat modified. After the exhibition of an emetic, and when the bowels have been well moved by a mercurial cathartic, the pulse must of course be subdued. But it is not necessary to do so with the haste which is absolutely necessary in strangers. The doses should not exceed five drops, and should not be given oftener than every hour and a half, for the first three doses. After this we must prescribe the *same dose* every two hours until the pulse is affected, which usually happens without vomiting or even nausea. I treat these cases just as I do a heavy bilious remittent, when I know the patient will surely get well if his fever is abolished by veratrum, and quinine given afterwards to prevent a recurrence. It is worthy of remark, as controlling our practice, that the children of wholly acclimated persons, are not themselves acclimated, being very liable to yellow fever, and prone to die of it. The treatment of such cases must be very vigorous, rigid and most watchful. Every practitioner at the South has had his painful lessons in this respect. Similar remarks apply to an acclimation engendered by a previous attack of yellow fever. This kind of immunity is not to be trusted. Every one who has had much experience in yellow fever, has witnessed cases of great severity where the patient has had the disease once, twice, or even three times before. The prognosis, however, is in general good, for the triumph of nature in the first attack, authorizes an expectation of similar successes afterwards.

The influence of the season of the year upon the progress of yellow fever is marked. In October, when the temperature has fallen very greatly, the natural disposition is towards recovery. Cases which under the excessive heat and humidity of August and September would have surely died, may now recover; where black vomit would have closed the scene, we now find hemor-

rhages from the mucous membranes, the tongue, nose, vagina and uterus especially. These hemorrhages, which I have never witnessed under the veratrum practice, are not fatal in the majority of cases. Many of them die, when a slow fever of irritative type accompanies them indicative of visceral trouble, but most of them get well with care and in time. Black vomit, choleraic congestion, cerebral congestion and suppression of urine, are altogether less frequent when the weather begins to grow cool, than in the earlier periods of the season. Patients not only grow fewer, but the intensity of the symptoms is less marked. Prolonged jaundice, however, is very common in the later periods of the season, accompanying the disposition towards hemorrhages.

It is especially early in the season, and whenever the weather is hot and humid, that the case should be mastered as quickly as possible, and most closely watched. In addition to the use of veratrum, frequent spongings of the skin with cool water to which aromatic vinegar and spirits have been added, or with tepid water and fanning, should be practiced whenever the patient is restless and the thermometer shows an unusual temperature, 102° to 103°. Later in the season when the air is cool, the ventilation should be free, and the application of cold to the skin will not be so often necessary.

As a disposition towards fever constitutes the strongest predisposition to yellow fever, we find that the disease declares itself with extreme facility in subjects who are already affected with intermittent or remittent fever. Such persons are very promptly attacked when submitted either to the influence of the contagion of yellow fever or of the effluvia of putrefaction. In the earlier periods of such cases the fever is prone to exacerbations in the afternoon, as shown under the employment of veratrum, not by the pulse, but by a rise in temperature and some disposition towards restlessness. When veratrum is not used, the chill may be repeated, the character of the case being betrayed by prolonged chilly sensations and minor degrees of rigor. Cases of this kind are often efficiently treated with large doses of quinine, but, as I have said with regard to remittent fever, I do not employ quinine as a basial remedy, preferring to rely upon veratrum, and to use quinine in conjunction with it. When used in cases of this kind, quinine is of undoubted value; but it must be given, as in remittent fever, in large doses, not less than fifty grains to a dram per diem, and must be held en-

tirely subject to the administration of veratrum. The prognosis is far better under the treatment indicated than with quinine alone, which is very apt to fail, and will almost surely do so early in the season. A multitude of cases occurring in the West are of this character, but few persons resident in the neighborhood of its great rivers being wholly free from malarial intoxication in some degree. As they are very susceptible to yellow fever, the disease spreads among them with great rapidity, and every form of malarial fever prevalent is converted into yellow fever. Shreveport, in 1873, and Vicksburg and Memphis, on several occasions, are notable illustrations of this remark. The treatment should be distinctly that for *yellow fever*, but should be aided with that proper to malarial fever. Quinine alone will not succeed, except in cases where partial acclimation to yellow fever exists, or the patient has already had the disease.

Veratrum is only admissible in the first stage of yellow fever. In practice, we are called, primarily, or in consultation, very often, to cases where this stage is far advanced or has passed. This is more frequently so in hospital practice, and under the auspices of the Howard Association, than in private practice. In 182 cases of yellow fever noted by me in 1854, in the Roper Hospital, in Charleston,—the notes of about half of which are still in my possession, and from which many of the tabular statements serving as a basis of the report of the physician in charge, Dr. W. T. Wragg, were computed—19 cases only were admitted on the first day, 44 on the second, 34 on the third, 16 on the fourth, 24 on the fifth, and 14 on the 6th, and so on with declining figures progressively to the fifteenth day. Out of those admitted on the first day, deducting 1 of unknown termination, 4 died only, or 22 per cent; of those on the second day, deducting 5 of unknown result, 8 died, or nearly 31 per cent; of those admitted on the third day, deducting 2 "unknown," 12 died, or 37½ per cent; of those on the fourth day, deducting 3 "unknown," 5 died, or 46 per cent; on the fifth day, deducting 1 unknown, 13 died, or 56 per cent; of those on the sixth day, deducting 1 unknown, 10 died, or 77 per cent; and of all admitted after this, up to the fifteenth day, viz., 31 cases, deducting 1 unknown, 10 died, or 32 per cent, which last category simply shows that patients capable of transportation to hospital, as late as the seventh day of illness, have the average chances of the disease from first to last, viz., about two to one. Dr. Wragg comments on these figures

as follows: "I think we may fairly infer that the prospective advantages of medical treatment are very decidedly lessened after the disease has progressed beyond the first day, and that the unfavorable prognosis continues until the sixth day. From this I would draw the conclusion that the sixth day is the turning point of the disease, and that all those who are fortunate enough to pass that period are comparatively safe." (*Charleston Med. Jour.*, 1855, p. 70) What is true for the expectant treatment, in conjunction, however, with the free use of calomel and quinine throughout the disease, is also true for the treatment by veratrum viride, and, indeed, for every other. The earlier the case is seen the better are the chances, and this is especially the case when veratrum is used. From the tables alluded to in Dr. Wragg's careful report, we find that the duration of the first and second stages were as follows:

FIRST STAGE.		SECOND STAGE.	
In 1 case	8 hours.	In 1 case.	15 hours.
In 2 cases	12 hours	In 80 cases	24 hours.
In 12 cases	24 hours.	In 2 cases	36 hours.
In 3 cases	36 hours	In 67 cases	48 hours.
In 52 cases	48 hours.	In 4 cases	72 hours.
In 102 cases	72 hours.	In 2 case	96 hours.
In 24 cases	96 hours		
In 2 cases	. days.		
In 2 cases	6 days.		
In 1 case	7 days.		
201 cases.		155 cases.	

As a rule, therefore, the first stage lasts three days, and the second twenty-four hours. As I have already said, veratrum should be administered as soon as the bowels have been moved, and in very severe cases concurrently with the cathartic. No time whatever should be lost. On the second day, veratrum will accomplish nearly as much as if given on the first day; but the chances of a successful employment of it, when administered on the third day, are not very good. The system is already overborne, the fever, usually, has begun to decline, the pulse has become windy, and an almost irreparable depravation of the blood has been effected by the exorbitant outflow of biliary matters from the liver, due to the unrestrained activity of the organ. No great advantage can accrue, therefore, from the administration of veratrum as late as this, *except in the most experienced* hands. It must be so given that the patient shall not vomit—in *small* doses, and in the form of powder—and should be at once

forborne if the pulse be found *rebellious*, as already described. Stimulants in great moderation, counter-irritants in the form of sinapisms, croton oil, or ammoniated liniments, should be used freely to the extremities and epigastrium. Opium must not be thought of, and the recovery of the patient should be in great part committed to the hands of nature. As may be seen from the table, however, the first stage lasts as long as four days, in about one-eighth of the cases; and as the length of this stage in any given case cannot be foretold, a cautious trial of veratrum will be proper *as long as the fever persists.* While there is fever there is reactivity, and it is upon this inherent power of life that the action of veratrum is based.

In the second and third stages of yellow fever, veratrum must never be given. It must borne in mind that a clear definition of the stages of yellow fever is only conspicuous when the disease is treated by some of the usual methods. When veratrum is employed and the pulse reduced, if the patient is to recover no second stage is ever apparent, the characteristic features of this stage, viz., exhaustion, languor and treacherous calmness, amid which stases of the organs, often fatal, are established, leading to black vomit and death by collapse in the third stage, do not become visible, inasmuch as all this is essentially obviated by the treatment employed. In this connection, the remark I am about to make is the result of very close attention, and I have thoroughly satisfied myself about it. *In adults*, the administration of veratrum must be continued *until the pulse rebels or black vomit begins to appear, when it must be at once discontinued and the restorative treatment cautiously adopted;* but in *children*, where, in consequence of the tenderness and vascularity of the walls of the stomach, gastric hemorrhage (black vomit) occurs much sooner and more readily than in adults, and much before the system is as yet exhausted to the same degree, veratrum *should be continued* in doses adequate to restrain the circulation *even after black vomit sets in*, and as long as the pulse *does not rebel.* By doing so, many of these little patients will be saved, who would otherwise in all probability die.

The indications for the employment of veratrum and the manner of its administration in different types of yellow fever are also matters which demand a careful consideration. The principal of these types are the malarial, which has been already noticed, the congestive or cyanotic, the gastric, the cerebral and the renal.

Certain cases occur in which visceral stasis is established almost from the first, or after a feeble and very short lived febrile reaction. The skin is dusky, the extremities shriveled, the lethargy profound, the intellect oppressed and perverted. There is either muttering, delirium or semi-coma. In such cases, veratrum will usually produce no good effect whatsoever, as the system is too severely stricken to respond to its stimulant influences upon the nervous centers. The failure of reaction implies the general failure of the powers of life, and the universal congestion has plainly fastened itself too securely upon the vital organs to be relieved by any measures acting through the nervous system. It is in cases like these, as well as those in which the first stage is nearly passed, and especially in the second stage, that I ventured to suggest the inhalation of oxygen and super oxygenated air in an article published in the *St. Louis Med. and Surg. Journal* for August, 1878. Of this practice I have had but little experience, having tried it, with great care, however, in only a single case, the notes of which were published in the September number of the same periodical for 1878. The results attained showed the practicability of the method and were undoubtedly encouraging as far as they went.

Very little can be done for cyanotic cases under any known mode of treatment, and the prognosis, as far as I have occasion to know, is that of inevitable and speedy death. The mode of death is closely similar to that of the algid stage of cholera, in which a general asphyxia of the economy is produced by the pulmonary congestion, to which, in cholera, is superadded the viscosity of the blood, and a diminution in its quantity, due to the immense and sudden drain of the discharges.

In the gastric type of yellow fever the nausea is pronounced from the beginning, and the vomiting very urgent and frequent. Nothing whatever can be retained in the stomach, and pain, oppression, and tenderness at the epigastrium are marked features early in the febrile stage. In these cases the indications for the administration of veratrum are the same as in other cases of sthenic type, but the drug must be administered very promptly *and by enema* in *double doses*, until the pulse has been reduced. It acts quite as well when given per anum as when administered by the mouth. After the primary reduction of the pulse, the effect of the veratrum should be maintained by a repetition of the doses by enema, until the irritability of the stomach declines,

as it will surely do, progressively with the reduction of congestion and consequent irritability in all other parts. When vomiting no longer occurs and the patient has been kept continuously under the influence of the remedy, veratrum may be administered by the mouth, as in ordinary cases, and will now, if judiciously given, perpetuate the gastric repose. It must be recollected that veratrum has no directly irritant effect upon the mucous membrane of the stomach or intestines, but acts solely through the nervous system. Its powers in quieting the stomach, so remarkably conspicuous in every properly managed case, will be greatly aided by sinapisms or other moderate counter-irritation to the epigastric region.

In the cerebral type of yellow fever we meet with some of the most difficult of all cases. The symptoms of cerebral congestion are marked from the first, or very early in the case. The patient lies insensible, motionless, the eyelids closed; the heart beats at 70 or more slowly still; the temperature is little if at all exalted; the bowels are obstinately constipated; there is no gastric irritability, nor vomiting, and an almost entire lack of responsiveness to every remedial measure whatsoever. If given by enema, veratrum may affect the pulse, but will not surely relieve the brain even temporarily. The strongest counter irritatants to the extremities, frictions or repeated hot baths, I have seen fail utterly, and after two or three days in which the condition does not seem to change, death closes the scene.

In other cases the cephalic congestion is accompanied with convulsions, and under the influence of veratrum, I have seen a return to consciousness with fair prospect of recovery. In the case I allude to, however, the correct principles of the administration of veratrum were departed from, and the convulsions returned, ushering in a speedy dissolution. In remittent fevers with similar cerebral congestion, and of equally intense grade, I have found that recovery, under veratrum, takes place in the very large proportion of cases, opium being carefully avoided, as it should be in all congestive fevers. In the case above alluded to, the veratrum was administered entirely by enema, until the patient recovered consciousness, and I would advise a similar course in all cases of the sort, as it is very difficult to get such patients to swallow. Ergot, likewise given by enema, in two dram doses, in conjunction with the veratrum, will be found very useful in conditions of this kind. I am strongly inclined to believe, that

the application of cylinders enveloping the legs from which the air is exhausted, and the exhibition of croton oil, will be of undoubted advantage. The head should be shaved and ice applied, and prompt vesication of the extremities effected by means of Granville's stronger lotion; whatever is gained in this way will be surely held by a concurrent administration of veratrum.

The renal function is never suppressed early in the progress of yellow fever, except in the intense congestive types. Suppression of urine, consequently, must be looked upon only as a sign of renal stasis, and its occurrence cannot be held to be distinctive as a form of yellow fever, or as a condition requiring any modification of the general rules of using veratrum. Total suppression is an *excessively rare occurrence under the use of veratrum*; indeed I do not recollect ever having seen it where the pulse has been systematically reduced during a period of several days, even when the patients died; the suppression in such cases being only partial. Death may be ushered in by progressive exhaustion with hiccough and black vomit, or the fearful agitation with colliquative sweating and decline of temperature, which accompany degrees of visceral and especially of pulmonary congestion, which veratrum may have failed to prevent, but the kidneys nearly always act to some extent. The existence of distinct symptoms of unusual renal congestion earlier than is common, is however, a condition which directly indicates the promptest and most energetic use of veratrum, in view of the primary importance of the function concerned. If suppression is not already complete, and febrile symptoms exist, the remedy should be pushed with the utmost rigor, and all adjuvant measures simultaneously adopted. No reliance can be placed in diuretics alone, and opium is sure to precipitate an impending suppression, and to render one already existing, irremediable by any therapeutical measure.

The advantages of the employment of veratrum viride in yellow fever in the way described, may be summarized as follows:

1st. A reduction of the mortality to one-third or even less than this, of what is usual in other modes of practice. In 1878, in the joint practice of Dr. White and myself, our mortality was eight or eight and a-half per cent, in the large number of cases treated, of a class in which yellow fever is most violent. The mortality of more than one-half of these cases, as shown on the books

of the Howard Association in 1858, was nine per cent, while the general mortality of all practice under the auspices of that association was 29 per cent; this figure itself being somewhat lower than it ought to have been, in consequence of the diminution produced by the small mortality under the veratrum treatment, which was counted in with the general records. Dr. D. Warren Brickell used veratrum in 1878, in New Orleans, in seventy or eighty cases, losing but three such patients, while before adopting the practice in the way described in this paper, and as originally published, his results had been in the neighboroood of 14 or 15 per cent. (See Dr. Brickell's remarks on the treatment of yellow fever before the St. Louis Medical Society, in the August number of the *St. Louis Medical and Surgical Journal* for 1879). Mitchell, of Memphis, employed it in a limited number of cases in 1873, with success. E. D. Fenner, of New Orleans, used veratrum in 1858, after White and myself had published the nature of the remedy we were employing, with great satisfaction.

Since the publication of our paper in 1858, veratrum has been very frequently used in yellow fever, but not by any means with a distinct conception of the scope or powers of the drug. I have myself employed it in a limited number of cases of yellow fever with the best results, and on a very extensive scale in the heavy forms of bilious, remittent and congestive fevers met with in Mississippi and Louisiana. Dr. White also used the remedy in Savannah a few years since.

Under the veratrum treatment, convalescence sets in very promptly, and is almost invariably uninterrupted. There are very seldom any sequelæ of consequence. Black vomit is rare, and is often recovered from, especially in children. Hemorrhages I have never seen. The jaundice is very slight, being limited almost wholly to the conjunctivæ. Total suppression of urine I have never seen under this treatment. The patients sleep frequently, and the terrible anxiety and jactitation so often observed in yellow fever under customary modes of treatment, is altogether absent. To the practitioner, its use saves an immense amount of solicitude, and to the nurse four fifths of the labor of nur ing; all that is requisite is watchfulness and punctuality.

Veratrum does not irritate the stomach or bowels, but directly reduces irritability of these organs, when due, as in heavy fevers, to congestion. I have already shown that the drug may be administered so as not to excite vomiting at all, or only a very

moderate primary vomiting, even in yellow fever. Its disposition to excite vomiting and occasionally to produce what I have called "cerebral veratrism," sinks into complete insignifiance when its wonderful powers are properly appreciated.

These are the only disadvantages that veratrum possesses, and experience has shown me that they are not only immensely overrated by timid practitioners, but, as I have said, may, with care and skill, be almost or altogether obviated. At the worst, they need never be feared, unless veratrum be given in doses three or four times as large as those I employ and recommend.

An assertion that I continually hear from a certain class of practitioners, with regard to the use of veratrum in yellow fever, and one which was especially dwelt upon in Charleston in 1858, is, that as yellow fever is essentially a hyposthenic disease, and veratrum a hyposthenisant, it must be necessarily unsuitable to the treatment of the disease, being distinctly contraindicated. Such a statement is based upon a double misconception. In the forms of yellow fever to which veratrum is applicable, there is always an exorbitant exhibition of force, as manifested in the high temperature, exalted frequency of the respiration and circulation, and nervous excitement. The plain tendency of the disease is towards death by exhaustion—by adynamia, but only after the first stage is past, and the adynamia is no more inherent in yellow fever than in any other form of fever, for in all fevers there is a characteristic hyposthenia, due to the appropriation by the excited tissues of more oxygen from the blood, than can be concurrently supplied even by the enhanced activity of the circulation and respiration. In yellow fever, the reactionary outburst is short lived, but intense while it lasts, and in typical cases this disease is more distinctly "sthenic," if the term can be properly applied to fevers of any sort, than any other febrile malady whatsoever. There is consequently in the first stage no inherent adynamia which would contra-indicate veratrum, were this drug a hyposthenisant. Such, however, is by no means its nature, for it is not at all similar in its mode of action to any of the recognized depressants, such as tartar emetic, aconite, tobacco, or gelseminum. Its action is peculiar, and consists in its powerful excitant or irritant effects upon the nervous system, and through this upon the vascular system. Instead of dissipating the resources of the econony, veratrum holds them in

check, prevents waste, and is essentially a conservator of force. Its lack of true depressing power is shown in the strength of the cardiac and arterial movements under its influence, the volume of the pulse, which is always good, however slow, and indeed characteristically full and strong, even while beating at 40 or 50 to the minute, and finally, by the total absence of irritability of the nervous sytem under its use, which would surely become obvious were the remedy essentially of depressing nature.

The truth is, veratrum acts in but one way, viz., by producing a contraction of the smaller arteries, including even the coronary arteries themselves, and so diminishing the activity of nutrition in every part. Its primary action *is not directed towards the heart* or its ganglia, but upon the muscular fibers proper to the small arteries. A recognition of this cardinal fact underlies the use of veratrum in all departments of medicine. I have found this out by observing that in cerebral veratrism the symptoms due to anæmia of the brain come on concurrently with the vomiting, or even before it, and with a general diminution of organic excitability in every part, invariably before the frequency of the heart's action is affected. Veratrum, therefore, does not produce its characteristic effects by primarily abating the activity of the heart's action, but it does so by first causing the smaller vessels to contract, including, as I have said, the branches of the coronary arteries, so that the diminution of the rapidity of the heart's beat must be regarded only as an evidence of the anæmia of the cardiac tissue, in common with a cotemporary anæmia of all the other organs. The slow pulse, consequently, being an indication of diminished cardiac vascularity, is also at the same time positive proof of the concurrent anæmia of other organs, an anæmia which is notably enhanced by the decreased rapidity of the circulation, which, moreover, affects the heart itself like the rest of the organs. The chain of phenomena thus becomes involved, and the conditions mutually reactive upon each other

Finally, I would say to my professional brethren, after twenty-two years of very extended experience with veratrum viride in fevers of every kind and degree, and in a great variety of other forms of disease, that if used in accordance with the principles I have now endeavored to expose, and with all the boldness, calmness, confidence and care attaching to its exhibition, two out of three, at least, of the patients which they will lose in various forms of fever, including yellow fever, under any known mode of prac-

tice whatsoever, will be saved alive. Such are my convictions, and such, moreover, has been my experience. In my opinion, the intelligent employment of veratrum is the only method of medication which in appropriate cases is entitled to rank as the *rational treatment of fever.*

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